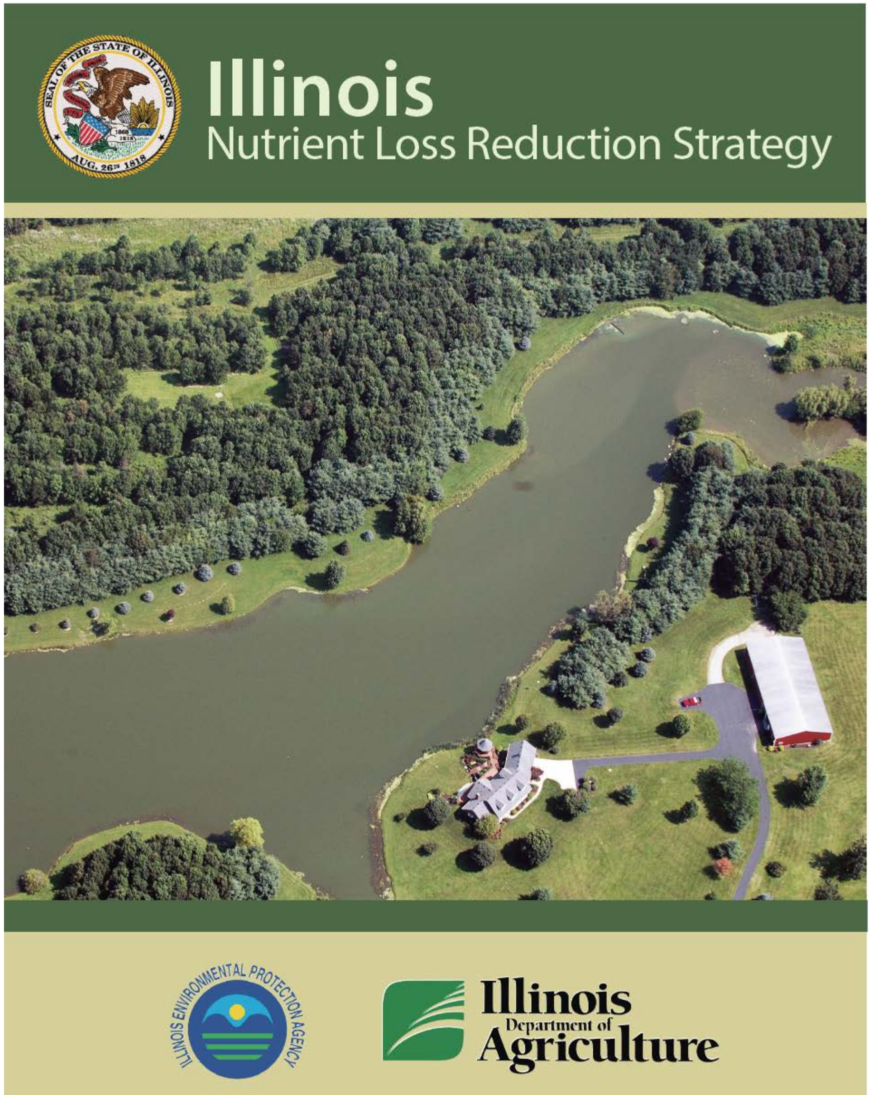
What Does the Illinois Nutrient Loss Reduction Strategy Mean for Water Quality in Illinois?

Mark B. David

University of Illinois at Urbana-Champaign

ISTC, December 3, 2015

Illinois NLRS



- USEPA asked all 12 states along Mississippi River to develop
- led by Dept. of Ag. and IEPA
- we did science assessment
- open process to develop
- 60 day public comment period closed Jan.24 (~1000 comments)

Local Water Quality

Copper Slough

Sangamon River Fisher

Jordan Creek

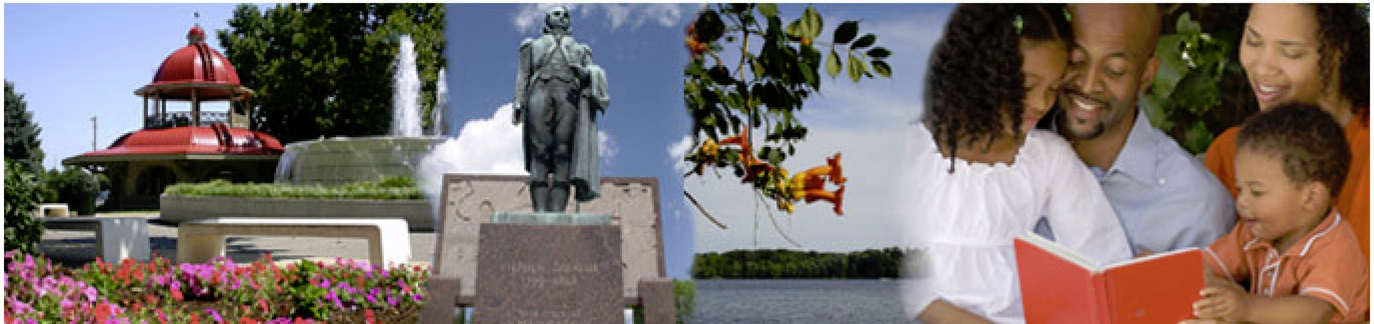
North Fork Salt Creek

Big Ditch Outlet

North Fork Vermilion

City of Decatur Illinois

1 Gary K. Anderson Plaza - Decatur, Illinois 62523 - (217) 424-2700



City Home Page
Water Management Main Page
Water Customer Service & Bill Payment
Public Information
Water Quality & Conservation
Services Provided
Other Websites
Contact Information

Water Management Services Provided

Water Production

Water Production provides potable water for the City of Decatur and the Village of Mt. Zion who together have an estimated population of 79,000. Lake Decatur serves as the sole raw water supply source, with the DeWitt County Well Field and an ex sand and gravel pit as back-up emergency supplies. The wells, when activated, discharge into the Sangamon River which supplies water to Lake Decatur. The Division operates and maintains the South Water Treatment Plant, William Street Pump Station, well field, two elevated water storage tanks, the Lake Decatur Dam, and lime residuals storage lagoons.

The City of Decatur Nitrate Removal Facility was completed in July of 2002.

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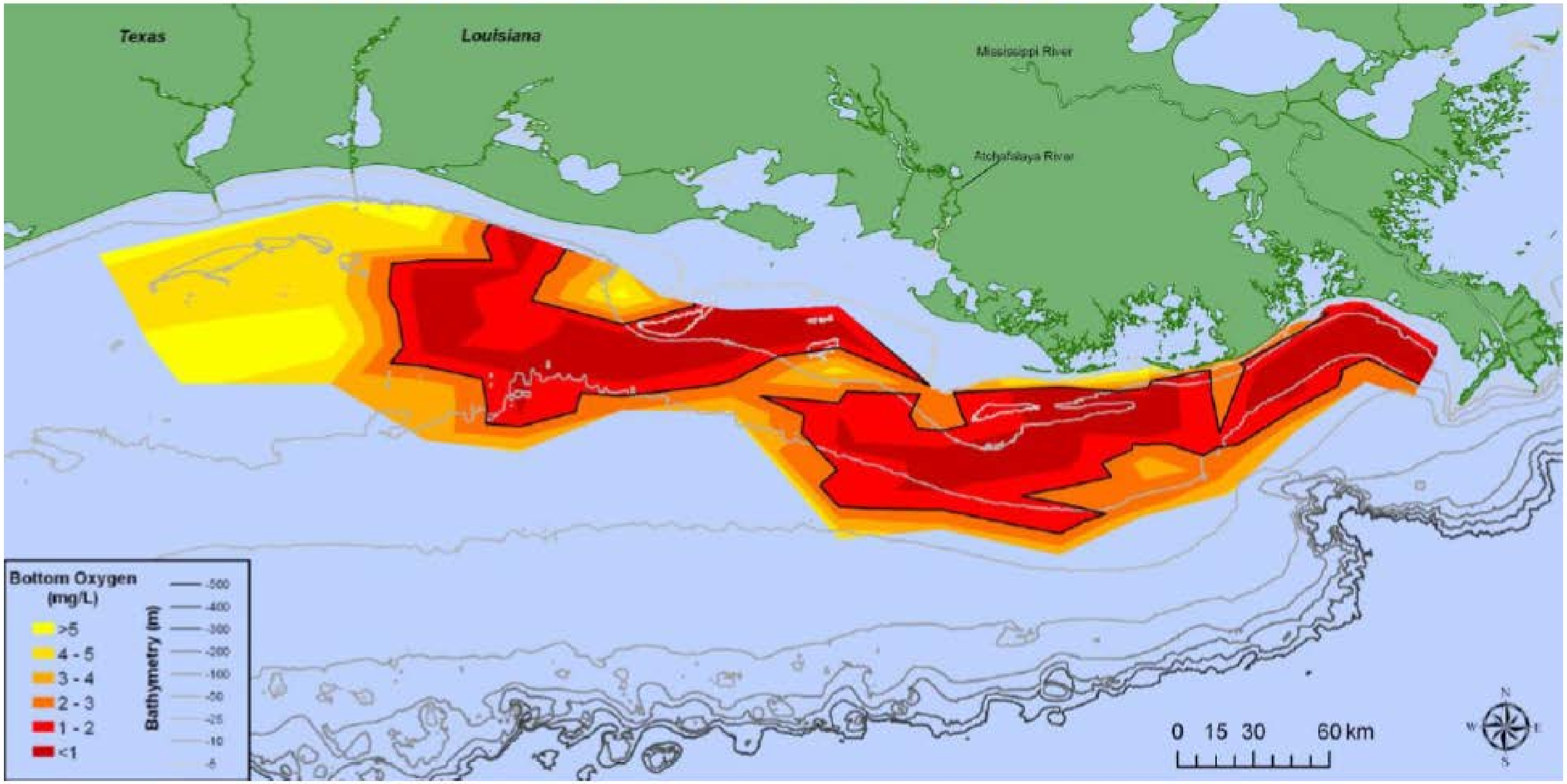
Hypoxic zone, 2015

Bottom Water Dissolved Oxygen – 2015



Distribution of bottom-water dissolved oxygen July 28-August 3, 2015 west of the Mississippi River delta. Black line denotes dissolved oxygen less than 2 mg/L.

Data source: Nancy N. Rabalais, LUMCON, and R. Eugene Turner, LSU

Funding sources: NOAA Center for Sponsored Coastal Ocean Research and U.S. EPA Gulf of Mexico Program

Gulf of Mexico Hypoxia

Action Plan

for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico

Mississippi River/Gulf of Mexico Watershed Nutrient Task Force

January 2001

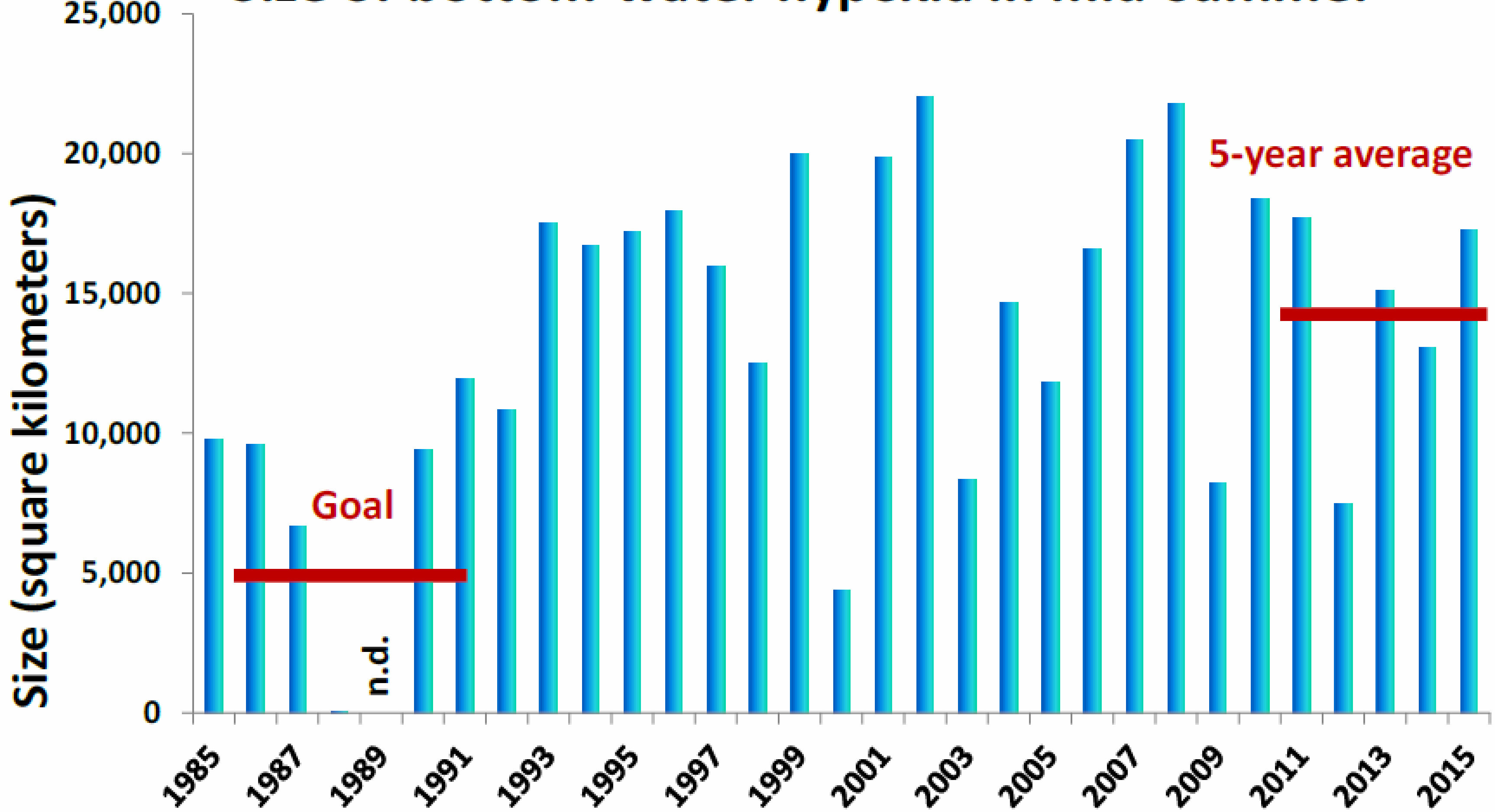
Gulf Hypoxia Action Plan 2008

for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin

Progress?

- 2008 Action Plan had target date of 2015 for reaching a 5,000 km^2 dead zone
  - driven by 45% nutrient load reductions
- on Feb. 12, 2015 new strategies were released
  - extended target date to 2035
  - to track progress and spur action, 20% reduction in nutrient loads by 2025

Size of bottom-water hypoxia in mid-summer



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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 16 2011

OFFICE OF
WATER

MEMORANDUM

SUBJECT: Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions

FROM: Nancy K. Stoner
Acting Assistant Administrator

TO: Regional Administrators, Regions 1-10

This memorandum reaffirms EPA's commitment to partnering with states and collaborating with stakeholders to make greater progress in accelerating the reduction of nitrogen and phosphorus loadings to our nation's waters. The memorandum synthesizes key principles that are guiding and that have guided Agency technical assistance and collaboration with states and urges the Regions to place new emphasis on working with states to achieve near-term reductions in nutrient loadings.

Over the last 50 years, as you know, the amount of nitrogen and phosphorus pollution entering our waters has escalated dramatically. The degradation of drinking and environmental water quality associated with excess levels of nitrogen and phosphorus in our nation's water has been studied and documented extensively, including in a recent joint report by a Task Group of senior state and EPA water quality and drinking water officials and managers.[1] As the Task Group report outlines, with U.S. population growth, nitrogen and phosphorus pollution from urban stormwater runoff, municipal wastewater discharges, air deposition, and agricultural livestock activities and row crop runoff is expected to grow as well. Nitrogen and phosphorus pollution has the potential to become one of the costliest and the most challenging environmental problems we face. A few examples of this trend include the following:

1) 50 percent of U.S. streams have medium to high levels of nitrogen and phosphorus.
2) 78 percent of assessed coastal waters exhibit eutrophication.
3) Nitrate drinking water violations have doubled in eight years.

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[1] *An Urgent Call to Action: Report of the State-EPA Nutrients Innovations Task Group*, August 2009.

Recommended Elements of a State Framework for Managing Nitrogen and Phosphorus Pollution

1. **Prioritize watersheds on a statewide basis for nitrogen and phosphorus loading reductions**
   A. Use best available information to estimate Nitrogen (N) & Phosphorus (P) loadings delivered to rivers, streams, lakes, reservoirs, etc. in all major watersheds across the state on a Hydrologic Unit Code (HUC) 8 watershed scale or smaller watershed (or a comparable basis.)
   B. Identify major watersheds that individually or collectively account for a substantial portion of loads (e.g. 80 percent) delivered from urban and/or agriculture sources to waters in a state or directly delivered to multi-jurisdictional waters.
   C. Within each major watershed that has been identified as accounting for the substantial portion of the load, identify targeted/priority sub-watersheds on a HUC 12 or similar scale to implement targeted N & P load reduction activities. Prioritization of sub-watersheds should reflect an evaluation of receiving water problems, public and private drinking water supply impacts, N & P loadings, opportunity to address high-risk N & P problems, or other related factors.

2. **Set watershed load reduction goals based upon best available information**

   Establish numeric goals for loading reductions for each targeted/priority sub-watershed (HUC 12 or similar scale) that will collectively reduce the majority of N & P loads from the HUC 8 major watersheds. Goals should be based upon best available physical, chemical, biological, and treatment/control information from local, state, and federal monitoring, guidance, and assistance activities including implementation of agriculture conservation practices, source water assessment evaluations, watershed planning activities, water quality assessment activities, Total Maximum Daily Loads (TMDL) implementation, and National Pollutant Discharge Elimination System (NPDES) permitting reviews.

3. **Ensure effectiveness of point source permits in targeted/priority sub-watersheds for:**
   A. Municipal and Industrial Wastewater Treatment Facilities that contribute to significant measurable N & P loadings;
   B. All Concentrated Animal Feeding Operations (CAFOs) that discharge or propose to discharge; and/or
   C. Urban Stormwater sources that discharge into N & P- impaired waters or are otherwise identified as a significant source.

4. **Agricultural Areas**

   In partnership with Federal and State Agricultural partners, NGOs, private sector partners, landowners, and other stakeholders, develop watershed-scale plans that target the most effective practices where they are needed most. Look for opportunities to include innovative approaches, such as targeted stewardship incentives, certainty agreements, and N & P markets, to accelerate adoption of agricultural conservation practices. Also, incorporate lessons learned from other successful agricultural initiatives in other parts of the country.

5. **Storm water and Septic systems**

   Identify how the State will use state, county and local government tools to assure N and P reductions from developed communities not covered by the Municipal Separate Storm Sewer Systems (MS4) program, including an evaluation of minimum criteria for septic systems, use of low impact development/ green infrastructure approaches, and/or limits on phosphorus in detergents and lawn fertilizers.

6. **Accountability and verification measures**
   A. Identify where and how each of the tools identified in sections 3, 4 and 5will be used within targeted/priority sub-watersheds to assure reductions will occur.
   B. Verify that load reduction practices are in place.
   C. To assess/demonstrate progress in implementing and maintaining management activities and achieving load reductions goals: establish a baseline of existing N & P loads and current Best Management Practices (BMP) implementation in each targeted/priority sub-watershed, conduct ongoing sampling and analysis to provide regular seasonal measurements of N & P loads leaving the watershed, and provide a description and confirmation of the degree of additional BMP implementation and maintenance activities.

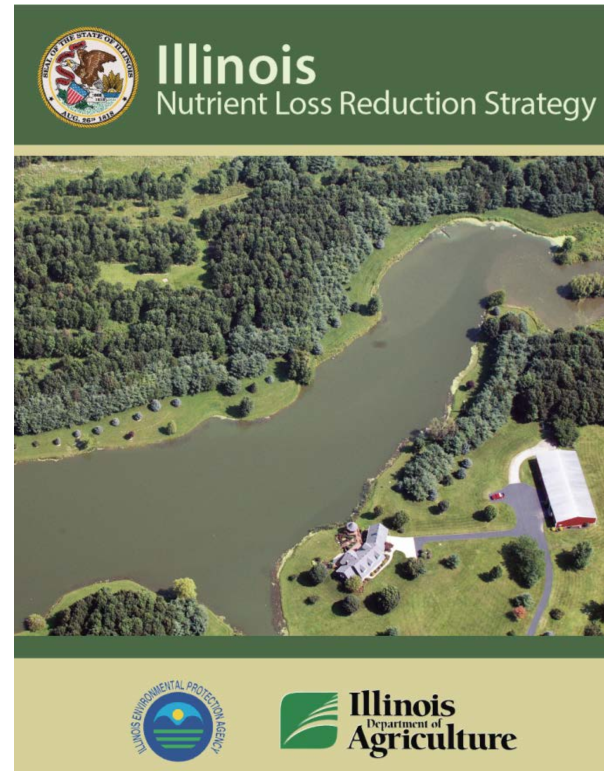
7. **Annual public reporting of implementation activities and biannual reporting of load reductions and environmental impacts associated with each management activity in targeted watersheds**
   A. Establish a process to annually report for each targeted/priority sub-watershed: status, challenges, and progress toward meeting N & P loading reduction goals, as well as specific activities the state has implemented to reduce N & P loads such as: reducing identified practices that result in excess N & P runoff and documenting and verifying implementation and maintenance of source-specific best management practices.
   B. Share annual report publically on the state's website with request for comments and feedback for an adaptive management approach to improve implementation, strengthen collaborative local, county, state, and federal partnerships, and identify additional opportunities for accelerating cost-effective N & P load reductions.

8. **Develop work plan and schedule for numeric criteria development**

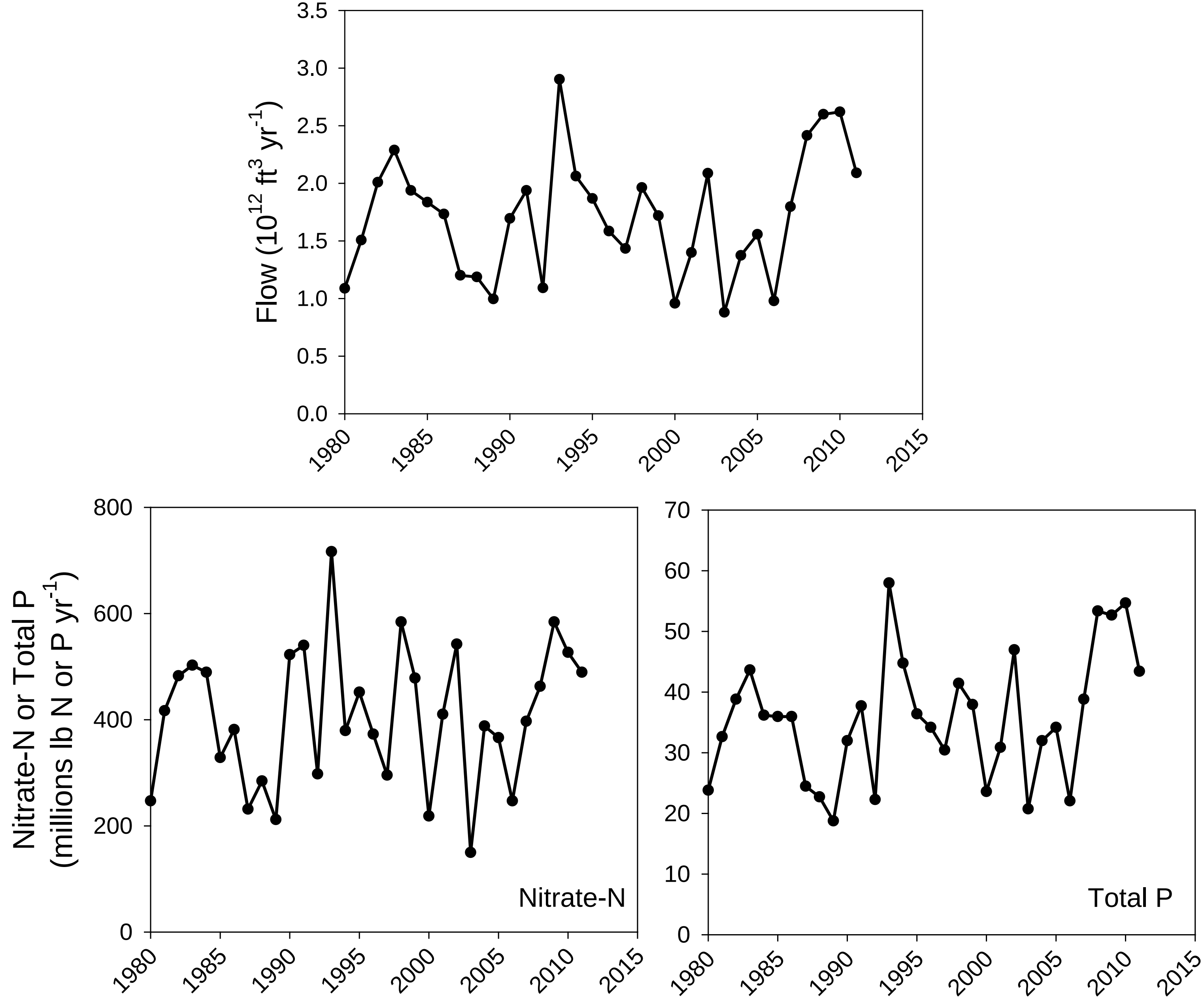
   Establish a work plan and phased schedule for N and P criteria development for classes of waters (e.g., lakes and reservoirs, or rivers and streams). The work plan and schedule should contain interim milestones including but not limited to data collection, data analysis, criteria proposal, and criteria adoption consistent with the Clean Water Act. A reasonable timetable would include developing numeric N and P criteria for at least one class of waters within the state (e.g., lakes and reservoirs, or rivers and streams) within 3-5 years (reflecting water quality and permit review cycles), and completion of criteria development in accordance with a robust, state-specific workplan and phased schedule.

Science Assessment for NLRS

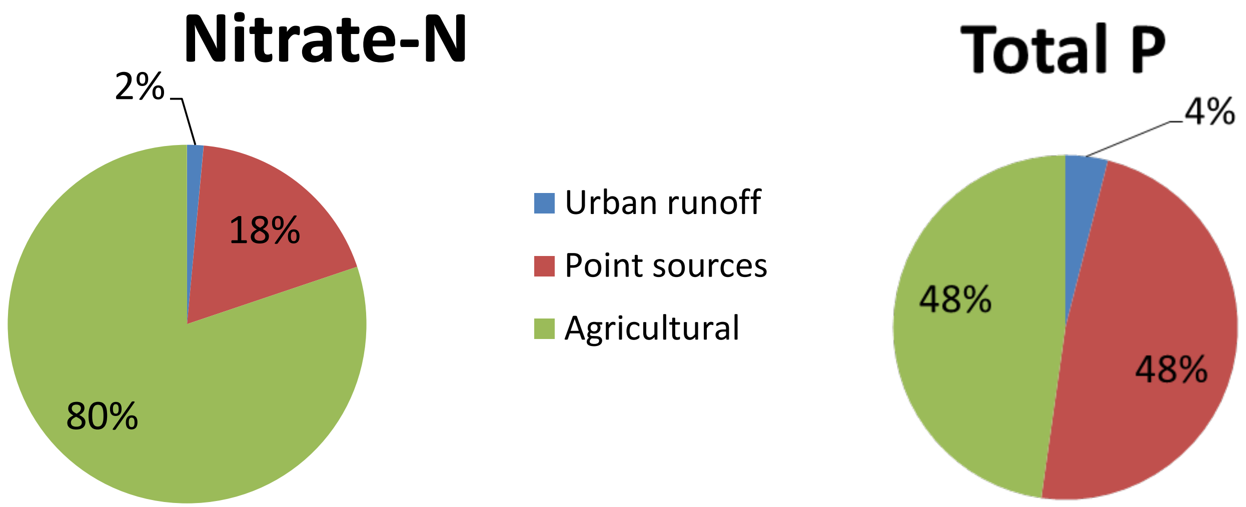
- science based technical assessment of:
  - current conditions in Illinois of nutrient sources and export by rivers
  - methods that could be used to reduce these losses and their effectiveness
  - estimates of the costs to reduce nutrient losses to meet local and Gulf of Mexico goals



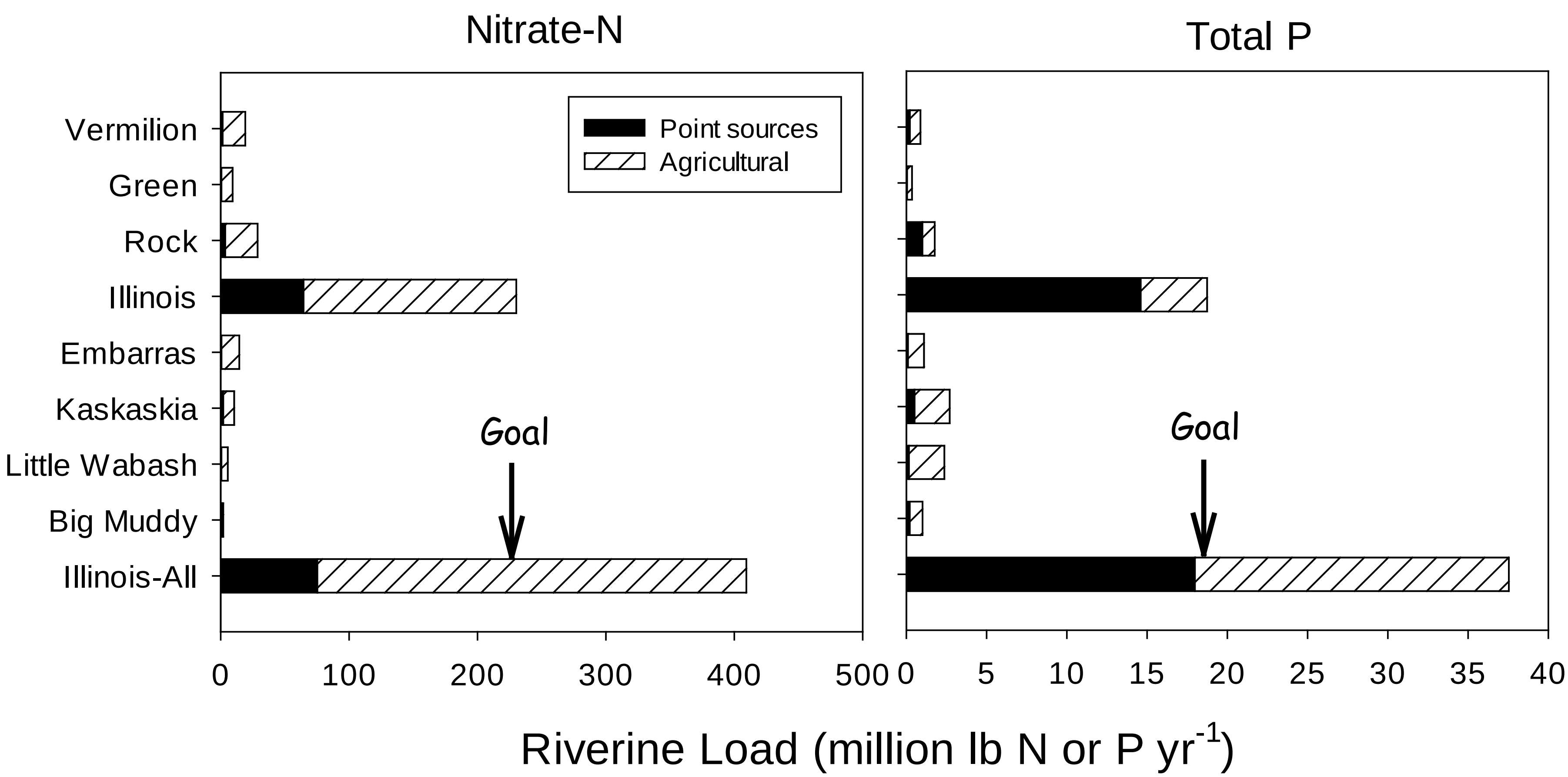
Water and nutrients leaving state are variable



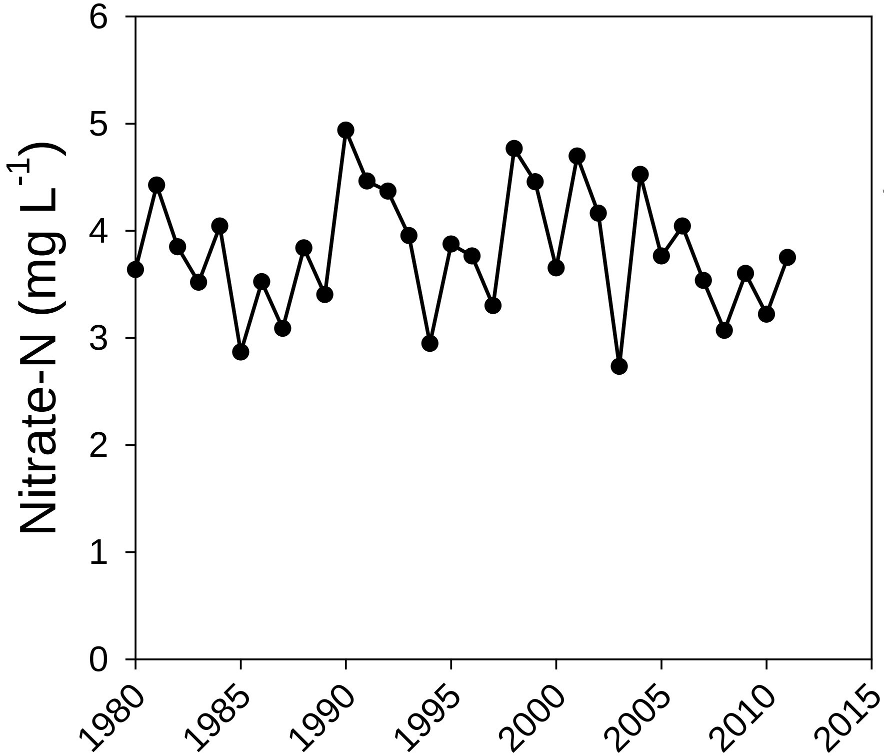
Illinois Nutrient Sources

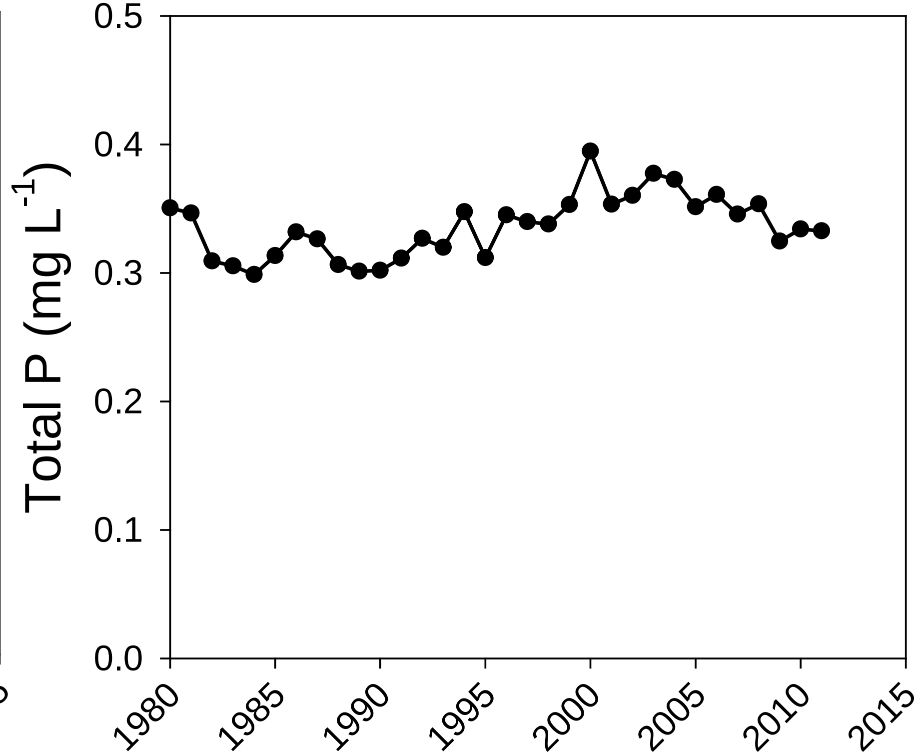


Point and agricultural sources

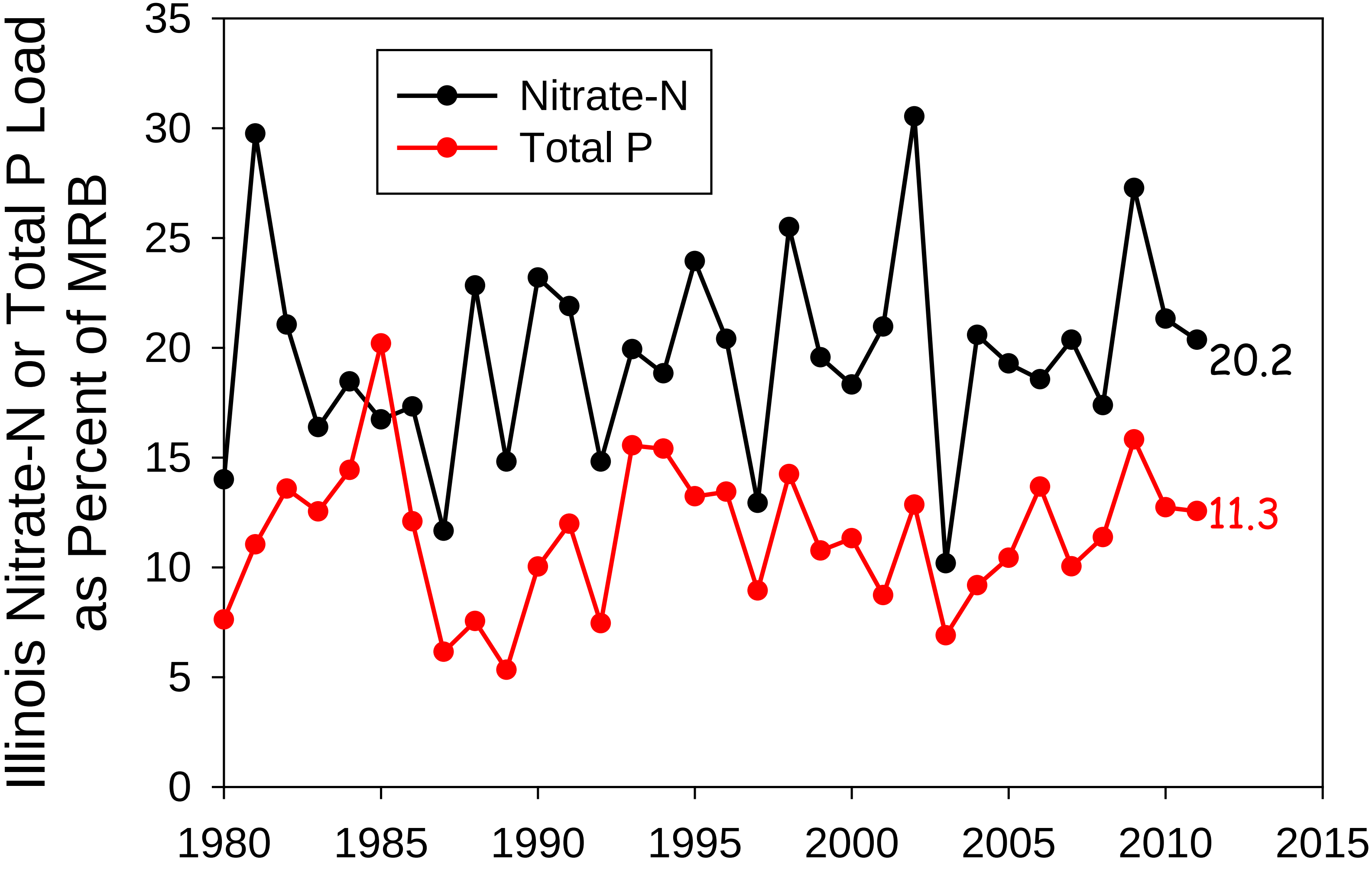


Average concentrations of nitrate and total P are quite high

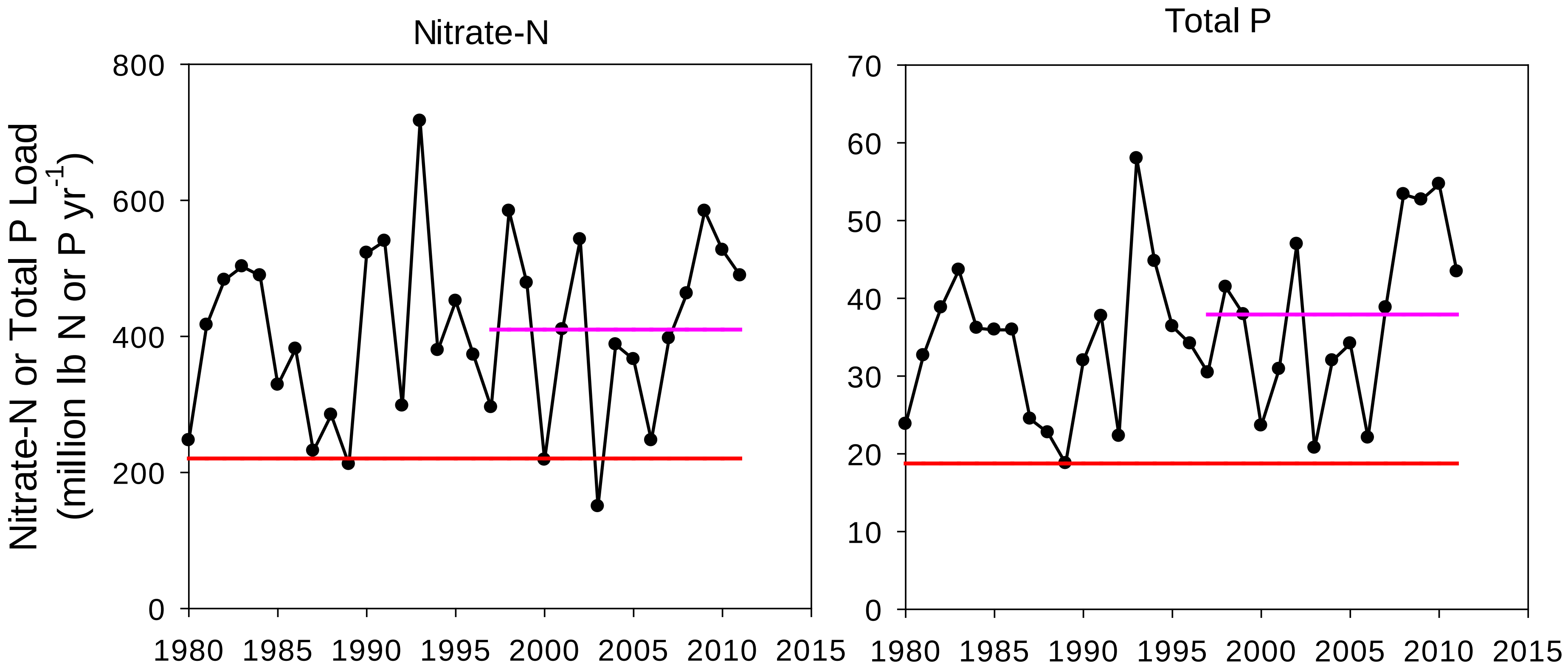




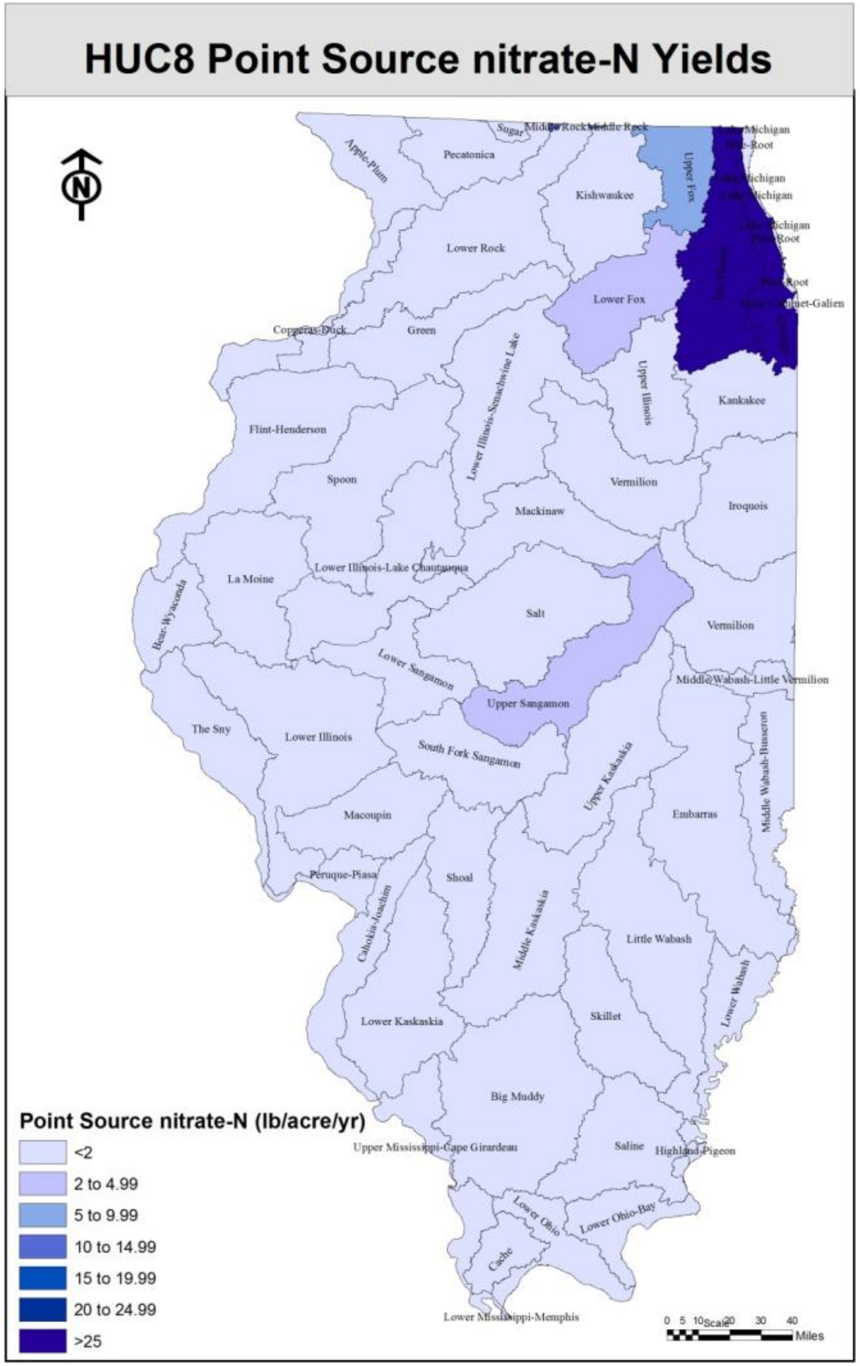
Illinois as % of MRB

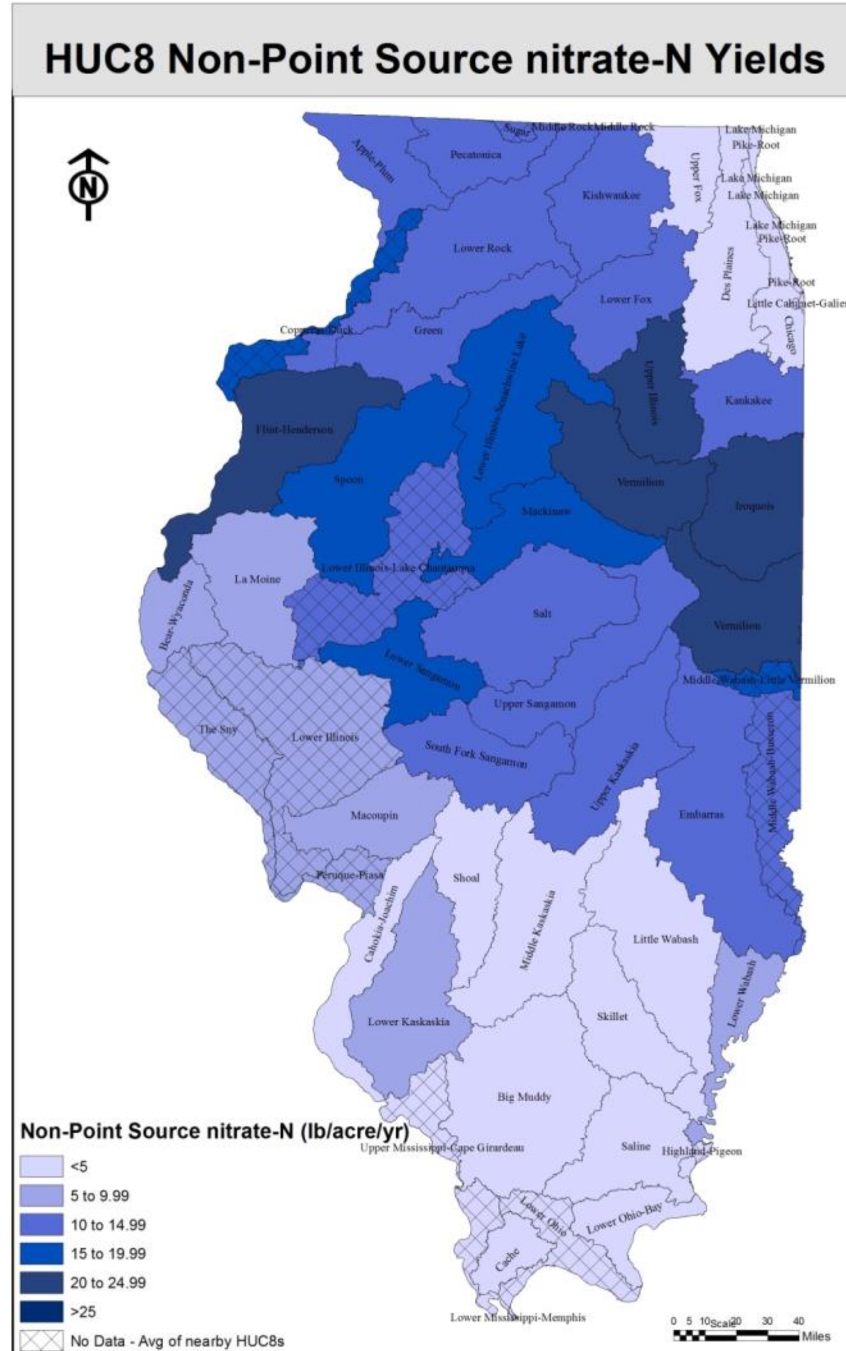


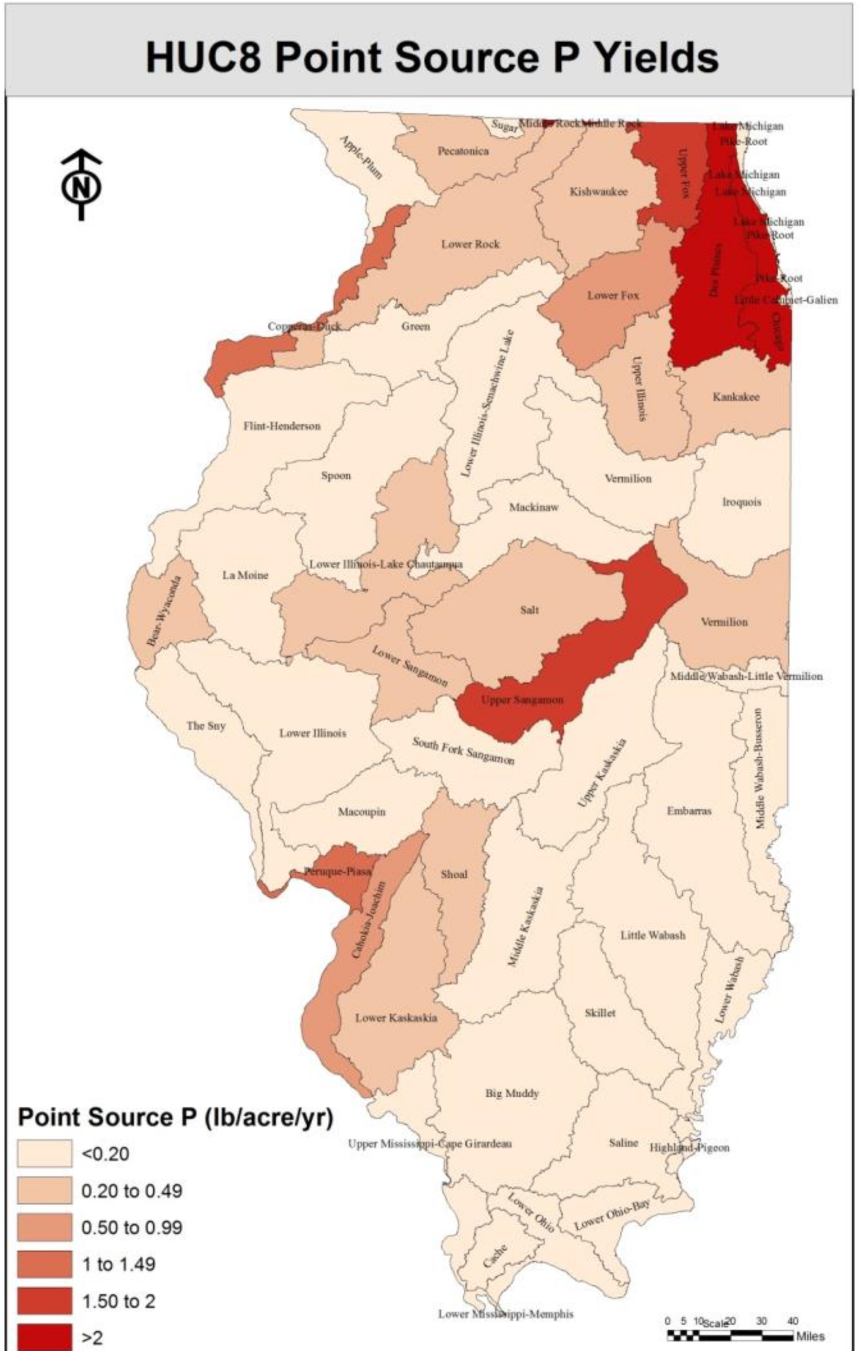
Targets call for large reductions

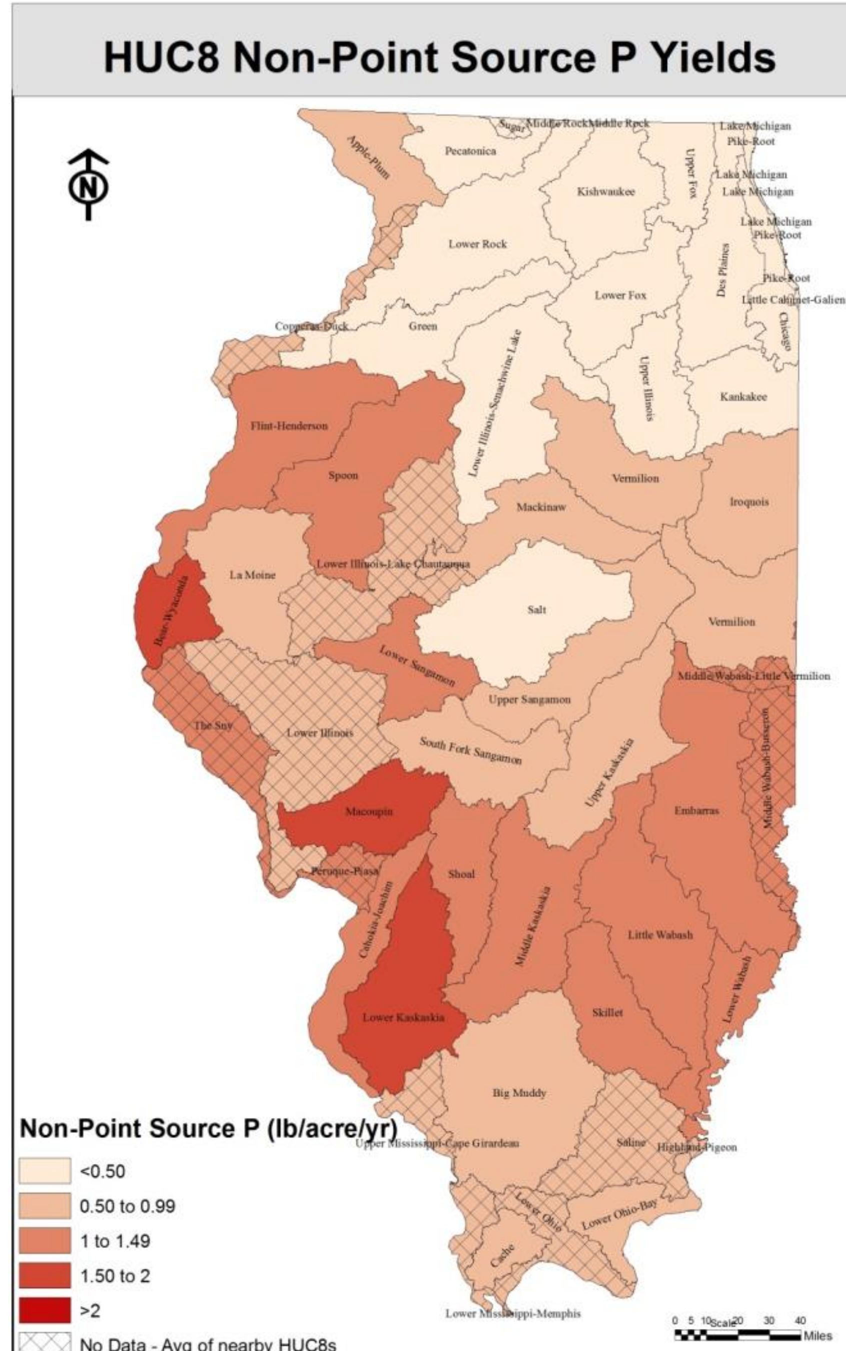


Red line is target, purple is average 1997 to 2011


HUC8 Point Source nitrate-N Yields
Point Source nitrate-N (lb/acre/yr)
<2
2 to 4.99
5 to 9.99
10 to 14.99
15 to 19.99
20 to 24.99
>25
0 5 10 Scale 20 30 40
Miles


HUC8 Non-Point Source nitrate-N Yields
Non-Point Source nitrate-N (lb/acre/yr)
<5
5 to 9.99
10 to 14.99
15 to 19.99
20 to 24.99
>25
No Data - Avg of nearby HUC8s
0 5 10 Scale 20 30 40
Miles

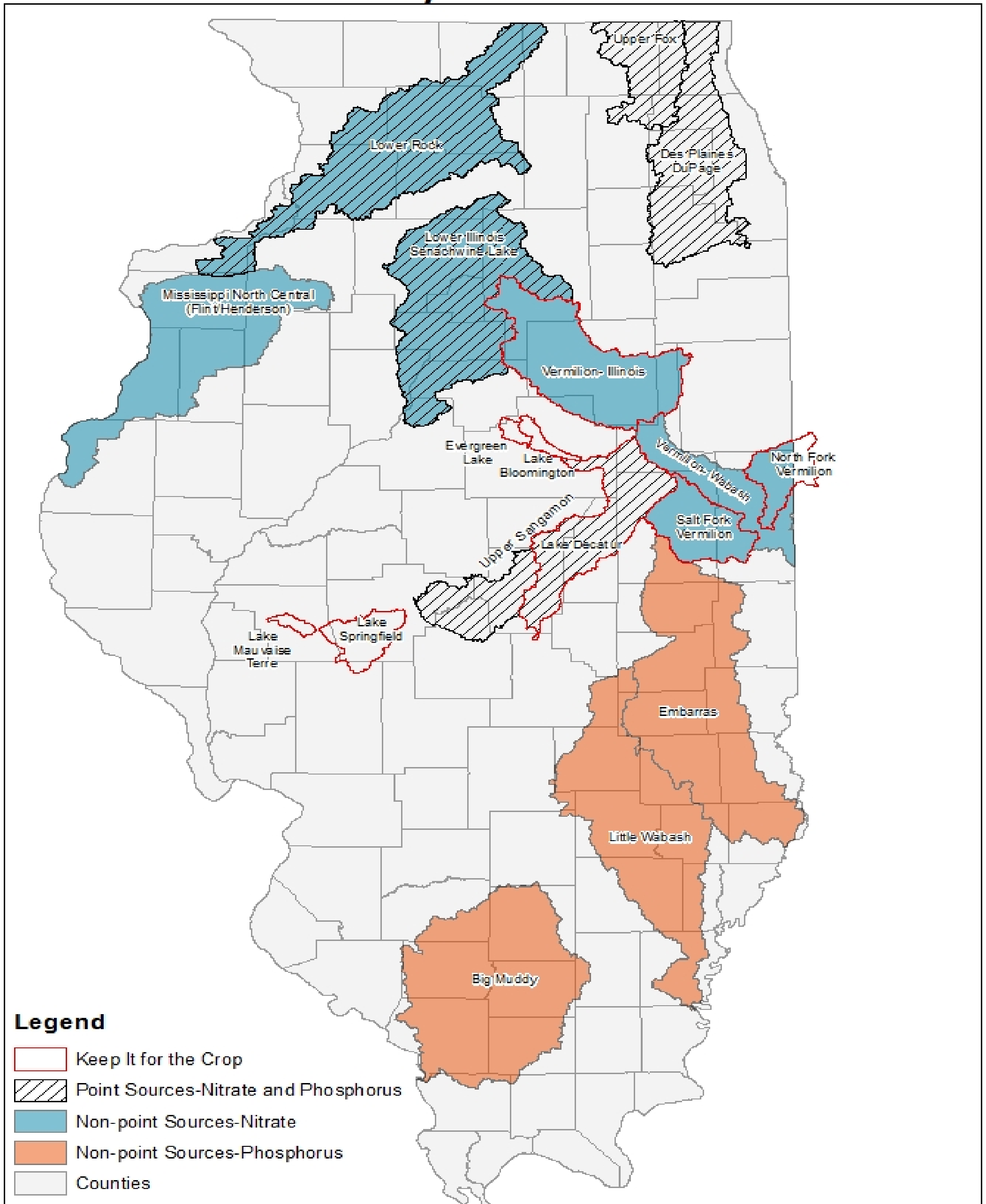

HUC8 Point Source P Yields
Point Source P (lb/acre/yr)
<0.20
0.20 to 0.49
0.50 to 0.99
1 to 1.49
1.50 to 2
>2
Apple-Plum
Sugar
Middle Rock
Pecatonica
Upper Fox
Lake Michigan
Pike-Root
Kishwaukee
Lower Rock
Des Plaines
Lower Fox
Little Calumet-Galien
Chicago
Copperas-Duck
Green
Upper Illinois
Kankakee
Flint-Henderson
Lower Illinois-Senachwine Lake
Spoon
Vermilion
Mackinaw
Iroquois
La Moine
Lower Illinois-Lake Chautauqua
Bear-Wyaconda
Salt
Lower Sangamon
Middle Wabash-Little Vermilion
Upper Sangamon
The Sny
Lower Illinois
South Fork Sangamon
Upper Kaskaskia
Middle Wabash-Busseron
Macoupin
Embarras
Peruque-Piasa
Shoal
Cahokia-Joachim
Middle Kaskaskia
Little Wabash
Skillet
Lower Wabash
Lower Kaskaskia
Big Muddy
Upper Mississippi-Cape Girardeau
Saline
Highland-Pigeon
Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
0 5 10 20 30 40
Scale
Miles


HUC8 Non-Point Source P Yields
Non-Point Source P (lb/acre/yr)
<0.50
0.50 to 0.99
1 to 1.49
1.50 to 2
>2
No Data - Avg of nearby HUC8s
Apple-Plum
Sugar
Middle Rock
Pecatonica
Upper Fox
Lake Michigan
Pike-Root
Kishwaukee
Lower Rock
Des Plaines
Lower Fox
Little Calumet-Galien
Chicago
Copperas-Duck
Green
Upper Illinois
Kankakee
Flint-Henderson
Lower Illinois-Senachwine Lake
Spoon
Vermilion
Mackinaw
Iroquois
La Moine
Lower Illinois-Lake Chautauqua
Bear-Wyaconda
Salt
Lower Sangamon
Middle Wabash-Little Vermilion
Upper Sangamon
The Sny
Lower Illinois
South Fork Sangamon
Upper Kaskaskia
Middle Wabash-Busseron
Macoupin
Embarras
Peruque-Piasa
Shoal
Cahokia-Joachim
Middle Kaskaskia
Little Wabash
Skillet
Lower Wabash
Lower Kaskaskia
Big Muddy
Upper Mississippi-Cape Girardeau
Saline
Highland-Pigeon
Lower Ohio
Lower Ohio-Bay
Cache
Lower Mississippi-Memphis
0 5 10 20 30 40
Scale
Miles

Point and non-point source N and P by HUC8 with impaired stream miles and lake acres.xlsx - Microsoft Excel

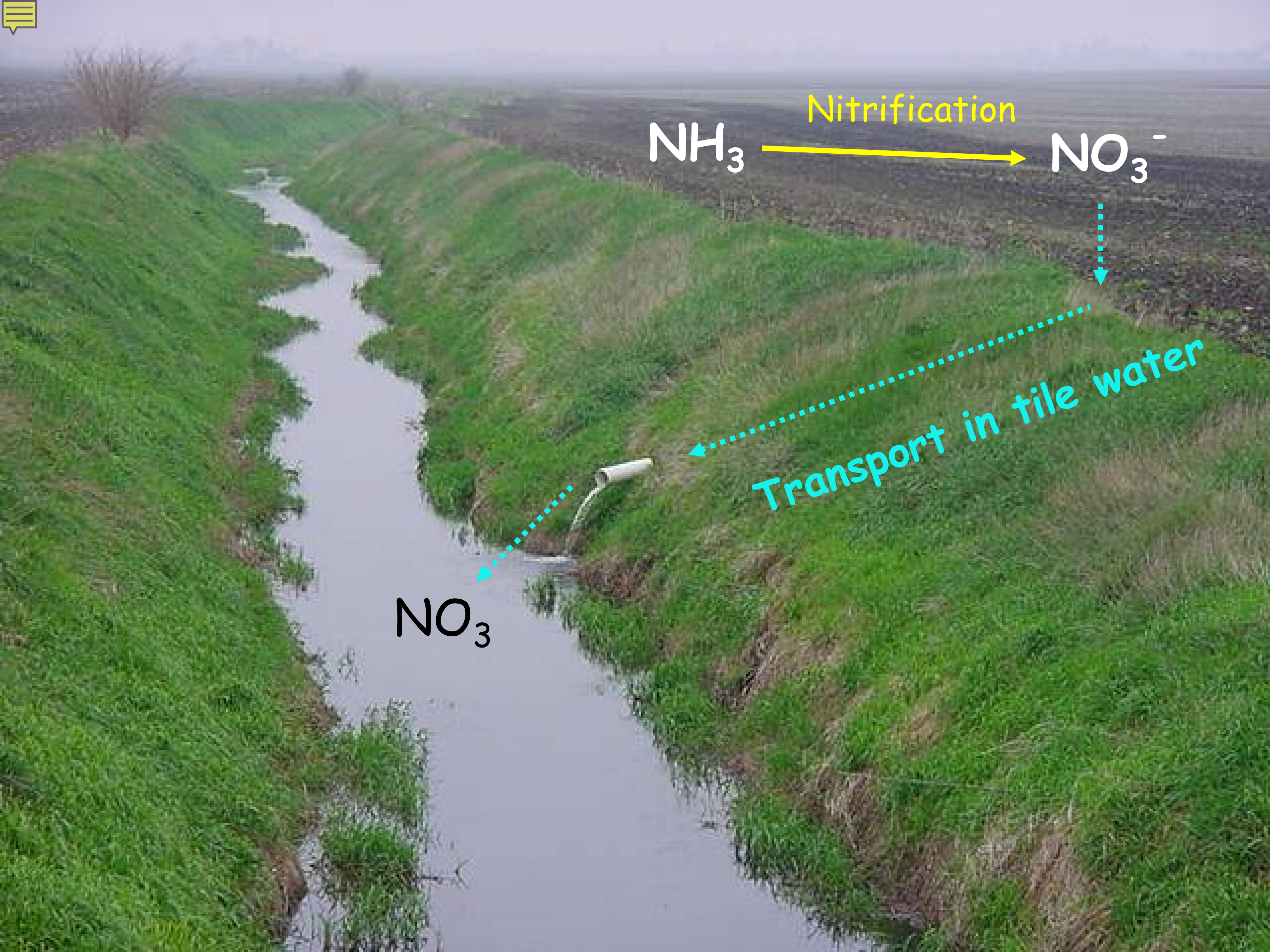
	A	B	C	D	E	F	G	H	I	J	K	L
1					Non-point							Non-point
			Total for HUC8	Point source	source					Total for HUC8	Point source	source
2	Name	HUC8	lbs N/acre/yr	lbs N/acre/yr	lbs N/acre/yr			Name	HUC8	lbs N/acre/yr	lbs N/acre/yr	lbs N/acre/yr
3												
4	Des Plaines	7120004	40.90	40.90	0.00			Flint-Henderson	7080104	24.08	0.48	23.61
5	Chicago	7120003	41.75	38.35	3.40			Upper Illinois	7120005	23.82	0.33	23.49
6	Middle Rock	7090002	27.17	12.88	14.29			Vermilion (IL)	7130002	22.57	0.42	22.15
7	Upper Fox	7120006	9.25	9.25	0.00			Iroquois	7120002	22.12	0.11	22.01
8	Lower Fox	7120007	14.09	3.87	10.23			Vermilion (Wabash)	5120109	21.94	1.66	20.28
9	Upper Sangamon	7130006	15.66	2.18	13.48			Mackinaw	7130004	20.07	0.20	19.87
10	Copperas-Duck	7080101	18.88	1.94	16.94			Lower Illinois-Senachwine Lake	7130001	18.82	0.50	18.32
11	Vermilion (Wabash)	5120109	21.94	1.66	20.28			Spoon	7130005	17.84	0.28	17.56
12	Cahokia-Joachim	7140101	2.50	1.60	0.90			Copperas-Duck	7080101	18.88	1.94	16.94
13	Lower Rock	7090005	15.43	1.45	13.98			Lower Sangamon	7130008	17.93	1.21	16.72
14	Kishwaukee	7090006	14.18	1.30	12.88			Middle Wabash-Lil Verm	5120108	16.06	0.33	15.73
15	Lower Sangamon	7130008	17.93	1.21	16.72			Salt	7130009	15.79	1.03	14.76
16	Lower Kaskaskia	7140204	6.42	1.12	5.30			Sugar	7090004	14.59	0.00	14.59
17	Salt	7130009	15.79	1.03	14.76			Pecatonica	7090003	15.34	0.76	14.59
18	Bear-Wyaconda	7110001	6.78	0.89	5.89			Middle Rock	7090002	27.17	12.88	14.29
19	Lower Illinois-Lake Chautauqua	7130003	14.90	0.88	14.01			Lower Illinois-Lake Chautauqua	7130003	14.90	0.88	14.01
20	South Fork Sangamon	7130007	14.18	0.81	13.38			Lower Rock	7090005	15.43	1.45	13.98
21	Pecatonica	7090003	15.34	0.76	14.59			Upper Sangamon	7130006	15.66	2.18	13.48
22	Big Muddy	7140106	1.43	0.71	0.72			South Fork Sangamon	7130007	14.18	0.81	13.38
23	Lower Illinois-Senachwine Lake	7130001	18.82	0.50	18.32			Apple-Plum	7060005	13.38	0.14	13.24
24	Flint-Henderson	7080104	24.08	0.48	23.61			Kishwaukee	7090006	14.18	1.30	12.88
25	La Moine	7130010	9.63	0.42	9.22			Green	7090007	12.65	0.14	12.51
26	Vermilion (IL)	7130002	22.57	0.42	22.15			Kankakee	7120001	12.67	0.37	12.30
27	Shoal	7140203	3.39	0.39	3.00			Upper Kaskaskia	7140201	11.69	0.32	11.37
28	Kankakee	7120001	12.67	0.37	12.30			Embarras (Lawrenceville)	5120112	11.51	0.34	11.17
29	Embarras (Lawrenceville)	5120112	11.51	0.34	11.17			Middle Wabash-Busseron	5120111	11.46	0.29	11.17
30	Upper Illinois	7120005	23.82	0.33	23.49			Lower Fox	7120007	14.09	3.87	10.23
31	Middle Wabash-Lil Verm	5120108	16.06	0.33	15.73			La Moine	7130010	9.63	0.42	9.22
32	Lower Illinois	7130011	8.12	0.32	7.79			Lower Illinois	7130011	8.12	0.32	7.79
33	Upper Kaskaskia	7140201	11.69	0.32	11.37			Macoupin	7130012	7.14	0.25	6.89
34	Little Wabash	5120114	3.49	0.32	3.17			The Sny	7110004	6.84	0.00	6.84
35	Lower Ohio	5140206	1.34	0.32	1.02			Lower Wabash	5120113	6.51	0.00	6.51
36	Middle Wabash-Busseron	5120111	11.46	0.29	11.17			Bear-Wyaconda	7110001	6.78	0.89	5.89
37	Spoon	7130005	17.84	0.28	17.56			Lower Kaskaskia	7140204	6.42	1.12	5.30
38	Macoupin	7130012	7.14	0.25	6.89			Peruque-Piasa	7110009	5.29	0.10	5.19
39	Middle Kaskaskia	7140202	3.57	0.23	3.34			Chicago	7120003	41.75	38.35	3.40
40	Upper Miss/Cape Girardeau	7140105	2.24	0.22	2.02			Middle Kaskaskia	7140202	3.57	0.23	3.34
41	Saline	5140204	1.07	0.20	0.87			Little Wabash	5120114	3.49	0.32	3.17
42	Mackinaw	7130004	20.07	0.20	19.87			Shoal	7140203	3.39	0.39	3.00
43	Green	7090007	12.65	0.14	12.51			Highland-Pigeon	5140202	2.69	0.00	2.69
44	Apple-Plum	7060005	13.38	0.14	13.24			Upper Miss/Cape Girardeau	7140105	2.24	0.22	2.02
45	Iroquois	7120002	22.12	0.11	22.01			Skillet	5120115	1.69	0.01	1.69
46	Peruque-Piasa	7110009	5.29	0.10	5.19			Cache	7140108	1.34	0.00	1.34
47	Skillet	5120115	1.69	0.01	1.69			Lower Ohio	5140206	1.34	0.32	1.02

Illinois Nutrient Loss Reduction Strategy
Priority Watersheds



Drainage by tiles and ditches

Patterned tile systems


Nitrification
$NH_3 \rightarrow NO_3^-$
Transport in tile water
NO_3

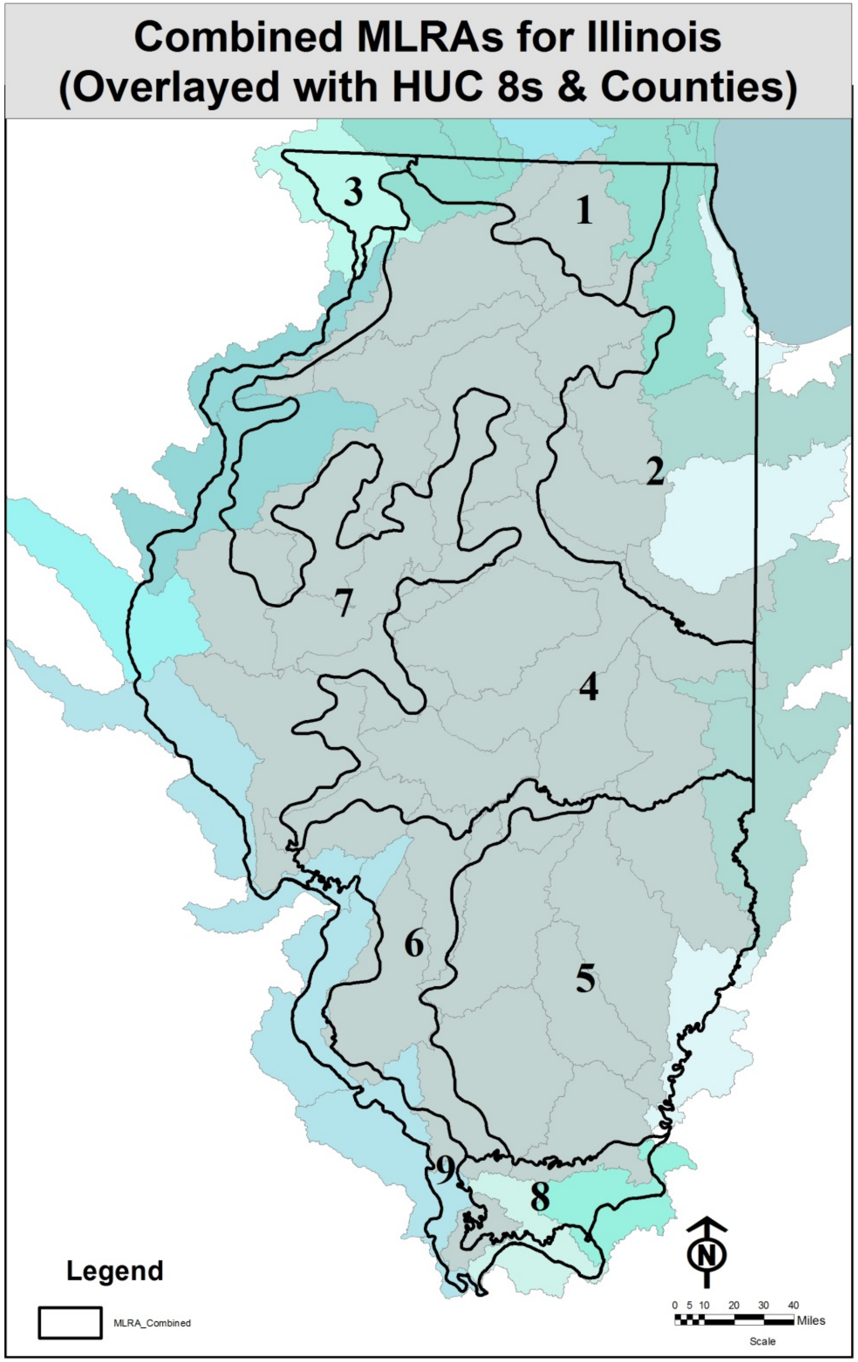

Surface Runoff

Major Land Resource Areas (MLRAs) from NRCS

Major Land Resource Areas (MLRAs) in Illinois, showing combinations to be used for analysis (15 combined into 9). Bold MLRAs are the numbers that will be used throughout our analysis.

		Landscape		Climate		
MLRA	Description	Elevation m (ft)	Local Relief m (ft)	Precipitation mm (inches)	Annual Temperature °C (°F)	Freeze Free Days
95B	Southern Wisconsin and Northern Illinois Drift Plain	200 to 300 (660 to 980)	8 (25)	760 to 965 (30 to 38)	6 to 9 (43 to 48)	170
97	Southwestern Michigan Fruit and Truck Crop Belt	200 to 305 (600 to 1000)	2 to 5 (5 to 15)	890 to 1,015 (35 to 40)	8 to 11 (47 to 52)	200
98	Southern Michigan and Northern Indiana Drift Plain	175 to 335 (570 to 1,100)	15 (5)	735 to 1,015 (29 to 40)	7 to 10 (44 to 50)	175
110	Northern Illinois and Indiana Heavy Till Plain	200 (650)	3 to 8 (10 to 25)	785 to 1,015 (31 to 40)	7 to 11 (42 to 52)	185
105	Northern Mississippi Valley Loess Hills	200 to 400 (660 to 1,310)	3 to 6 (10 to 20)	760 to 965 (30 to 38)	6 to 10 (42 to 50)	175
108A	Illinois and Iowa Deep Loess and Drift, Eastern Part	200 to 300 (660 to 985)	1 to 3 (3 to 10)	890 to 1,090 (35 to 43)	8 to 12 (47 to 54)	195
108B	Illinois and Iowa Deep Loess and Drift, East-Central Part	200 to 300 (660 to 985)	1 to 3 (3 to 10)	840 to 990 (33 to 39)	8 to 12 (47 to 54)	185
113	Central Claypan Areas	200 (660)	1.5 to 3 (5 to 10)	915 to 1,170 (36 to 46)	11 to 14 (51 to 57)	205
115A	Central Mississippi Valley Wooded Slopes, Eastern Part	100 to 310 (320 to 1,020)	3 to 15 (10 to 50)	1,015 to 1,195 (40 to 47)	11 to 14 (53 to 57)	210
114B	Southern Illinois and Indiana Thin Loess and Till Plain, Western Part	105 to 365 (350 to 1,190)	3 to 15 (10 to 50)	940 to 1,170 (37 to 46)	11 to 14 (52 to 56	210
115C	Central Mississippi Valley Wooded Slopes, Northern Part	130 to 270 (420 to 885)	3 to 6 (10 to 20)	865 to 1,015 (34 to 40)	9 to 13 (48 to 55)	200
120A	Kentucky and Indiana Sandstone and Shale Hills and Valleys, Southern Part	105 to 290 (345 to 950)	Varies widely	1,145 to 1,370 (45 to 54)	13 to 14 (55 to 58)	210
115B	Central Mississippi Valley Wooded Slopes, Western Part	100 to 310 (320 to 1,020)	3 to 15 (10 to 50)	965 to 1,220 (38 to 48)	12 to 14 (53 to 57)	205
131A	Southern Mississippi River Alluvium	0 to 100 (0 to 330	Max 5 (15)	1,170 to 1,525 (46 to 60)	14 to 21 (56 to 69)	210 (North)
134	Southern Mississippi Valley Loess	25 to 185 (80 to 600)	3 to 6 (10 to 20)	1,195 to 1,525 (47 to 60)	14 to 20 (57 to 68)	215 (North)

Compiled agricultural data at various scales, combined using GIS to nine MLRAs



Agricultural Management by MLRA

Combined MLRA	Description	Corn (acres)	Soybean (acres)	Wheat (acres)	Drained acres (% of crop acres)	Corn yield (bushels /acre)	Soybean yield (bushels /acre)
MLRA 1	Northern Illinois drift plain	515,905	224,186	20,192	288,491 (39)	161	48
MLRA 2	Northeastern Illinois heavy till plain	1,532,100	1,111,885	42,404	2,063,695 (78)	150	39
MLRA 3	Northern Mississippi Valley	163,507	52,432	1,975	20,942 (10)	160	50
MLRA 4	Deep loess and drift	5,579,980	3,343,444	76,078	5,437,807 (61)	164	52
MLRA 5	Claypan	1,609,633	1,991,939	352,839	310,087 (9)	128	39
MLRA 6	Thin loess and till	664,242	689,773	161,180	226,971 (17)	130	42
MLRA 7	Central Mississippi Valley, Northern Part	2,058,853	1,288,686	73,884	1,284,588 (38)	155	49
MLRA 8	Sandstone and shale hills and valleys	83,969	115,244	10,658	49,565 (25)	103	33
MLRA 9	Central Mississippi Valley, Western Part	203,736	314,662	78,250	23,769 (5)	125	39
Sum		12,411,925	9,132,251	817,460	9,705,916 (43)		

Average crop acres and yields 2008 through 2012

Agricultural N Management by MLRA

Combined MLRA	Description	Estimated corn fertilizer (lbs N/acre/yr)	Estimated corn fertilizer + manure (lbs N/acre/yr)	Row crops (acres)	Nitrate-N yield per row crop acre (lbs N/acre/yr)
MLRA 1	Northern Illinois drift plain	152	168	760,283	20.4
MLRA 2	Northeastern Illinois heavy till plain	158	164	2,686,389	25.0
MLRA 3	Northern Mississippi Valley	135	158	217,914	31.3
MLRA 4	Deep loess and drift	150	159	8,999,502	19.6
MLRA 5	Claypan	180	196	3,954,411	6.6
MLRA 6	Thin loess and till	156	170	1,515,195	7.4
MLRA 7	Central Mississippi Valley, Northern Part	155	169	3,421,423	24.5
MLRA 8	Sandstone and shale hills and valleys	209	219	209,871	3.9
MLRA 9	Central Mississippi Valley, Western Part	192	204	596,648	4.0
Sum		157	168	22,361,636	

Corn Fertilizer N by MLRA

Combined MLRA	Description	Estimated CS fertilizer + manure (lb/acre/yr)	MRTN (10 to 1) CS (lb N/acre/yr)	Estimated CC fertilizer + manure (lb/acre/yr)	MRTN (10 to 1) CC (lb N/acre/yr)
MLRA 1	Northern Illinois drift plain	156	146	196	199
MLRA 2	Northeastern Illinois heavy till plain	151	155	190	197
MLRA 3	Northern Mississippi Valley	146	146	184	199
MLRA 4	Deep loess and drift	147	155	185	197
MLRA 5	Claypan	181	171	227	189
MLRA 6	Thin loess and till	157	171	198	189
MLRA 7	Central Mississippi Valley, Northern Part	156	163	197	194
MLRA 8	Sandstone and shale hills and valleys	202	171	254	189
MLRA 9	Central Mississippi Valley, Western Part	188	171	237	189

MRTN is Maximum Return to N

Nitrate Yield by MLRA

Combined MLRA	Description	Drained cropland (acres)	Nitrate-N yield per row crop acre (lb N/acre/yr)	Nitrate-N yield per tile drained acre (lb N/acre/yr)	Nitrate-N yield from non-tiled land (lb N/acre/yr)
MLRA 1	Northern Illinois drift plain	288,491	20.4	43	6.6
MLRA 2	Northeastern Illinois heavy till plain	2,063,695	25.0	29	10.8
MLRA 3	Northern Mississippi Valley	20,942	31.3		31.3
MLRA 4	Deep loess and drift	5,437,807	19.6	26	9.9
MLRA 5	Claypan	310,087	6.6		6.6
MLRA 6	Thin loess and till	226,971	7.4	30	3.5
MLRA 7	Central Mississippi Valley, Northern Part	1,284,588	24.5	46	11.8
MLRA 8	Sandstone and shale hills and valleys	49,565	3.9		3.9
MLRA 9	Central Mississippi Valley, Western Part	23,769	4.0		4.0

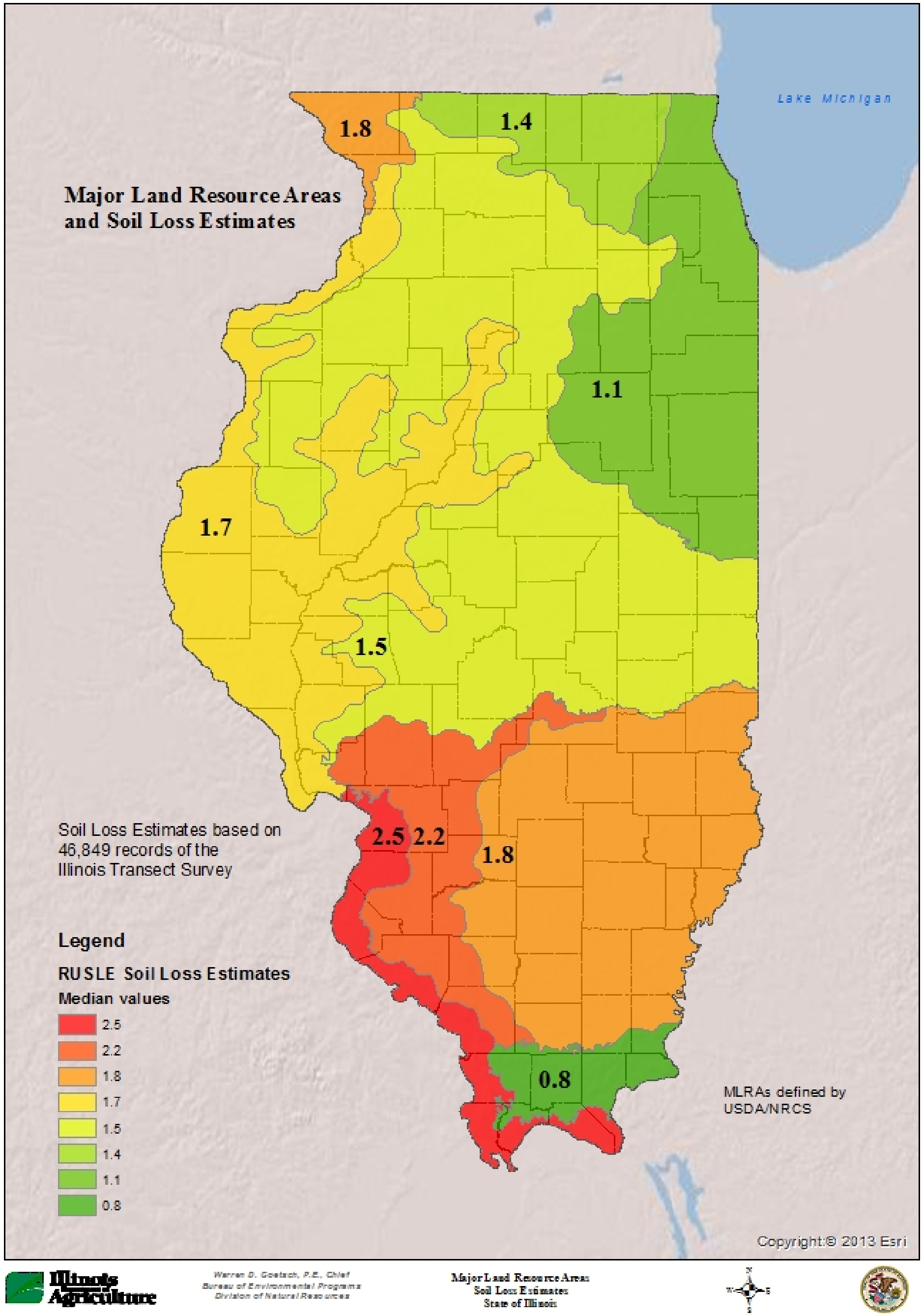
Nitrate Yield by MLRA

Combined MLRA	Description	Drained cropland (acres)	Nitrate-N yield per row crop acre (lb N/acre/yr)	Nitrate-N yield per tile drained acre (lb N/acre/yr)	Nitrate-N yield from non-tiled land (lb N/acre/yr)
MLRA 1	Northern Illinois drift plain	288,491	20.4	43	6.6
MLRA 2	Northeastern Illinois heavy till plain	2,063,695	25.0	29	10.8
MLRA 3	Northern Mississippi Valley	20,942	31.3		31.3
MLRA 4	Deep loess and drift	5,437,807	19.6	26	9.9
MLRA 5	Claypan	310,087	6.6		6.6
MLRA 6	Thin loess and till	226,971	7.4	30	3.5
MLRA 7	Central Mississippi Valley, Northern Part	1,284,588	24.5	46	11.8
MLRA 8	Sandstone and shale hills and valleys	49,565	3.9		3.9
MLRA 9	Central Mississippi Valley, Western Part	23,769	4.0		4.0

Agricultural P Management by MLRA

Combined MLRA	Description	Estimated fertilizer (lb P/acre/yr)	Estimated manure (lb P/acre/yr)	Row crops (acres)	Total P yield per row crop acre (lb P/acre/yr)
MLRA 1	Northern Illinois drift plain	14.9	3.9	760,283	0.71
MLRA 2	Northeastern Illinois heavy till plain	13.4	1.3	2,686,389	0.68
MLRA 3	Northern Mississippi Valley	13.4	5.4	217,914	1.72
MLRA 4	Deep loess and drift	13.6	2.3	8,999,502	0.87
MLRA 5	Claypan	11.7	2.4	3,954,411	1.74
MLRA 6	Thin loess and till	11.3	2.5	1,515,195	2.09
MLRA 7	Central Mississippi Valley, Northern Part	13.6	3.4	3,421,423	1.45
MLRA 8	Sandstone and shale hills and valleys	11.3	1.3	209,871	2.82
MLRA 9	Central Mississippi Valley, Western Part	11.0	1.6	596,648	2.82
Sum				22,361,636	

Illinois Transect Survey Soil Loss Estimates



Iowa Strategy to Reduce Nutrient Loss: Nitrogen Practices

This table lists practices with the largest potential impact on nitrate-N concentration reduction (except where noted). Corn yield impacts associated with each practice also are shown as some practices may be detrimental to corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% Nitrate-N Reduction+	% Corn Yield Change++
			Average (SD*)	Average (SD*)
Nitrogen Management	Timing	Moving from fall to spring pre-plant application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to fall-applied	5 (28)	10 (7)
		Sidedress – Compared to pre-plant application	7 (37)	0 (3)
		Sidedress – Soil test based compared to pre-plant	4 (20)	13 (22)**
	Source	Liquid swine manure compared to spring-applied fertilizer	4 (11)	0 (13)
		Poultry manure compared to spring-applied fertilizer	-3 (20)	-2 (14)
	Nitrogen Application Rate	Nitrogen rate at the MRTN (0.10 N:corn price ratio) compared to current estimated application rate. (ISU Corn Nitrogen Rate Calculator – http://extension.agron.iastate.edu/soilfertility/nrate.aspx can be used to estimate MRTN but this would change Nitrate-N concentration reduction)	10	-1
	Nitrification Inhibitor	Nitrapyrin in fall – Compared to fall-applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29)	-6 (7)
		Oat	28 (2)	-5 (1)
	Living Mulches	e.g. Kura clover – Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops – Compared to spring-applied fertilizer	72 (23)	
		Land Retirement (CRP) – Compared to spring-applied fertilizer	85 (9)	
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa – assume similar to CRP	85	
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)	
	Shallow Drainage	No impact on concentration	32 (15)	
	Wetlands	Targeted water quality	52	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream.	91 (20)	

+ A positive number is nitrate concentration or load reduction and a negative number is an increase.

++ A positive corn yield change is increased yield and a negative number is decreased yield. Practices are not expected to affect soybean yield.

* SD – standard deviation. Large SD relative to the average indicates highly variable results.

** This increase in crop yield should be viewed with caution as the sidedress treatment from one of the main studies had 95 lb-N/acre for the pre-plant treatment but 110 lb-N/acre to 200 lb-N/acre for the sidedress with soil test treatment so the corn yield impact may be due to nitrogen application rate differences.

Water Quality Improvement Case Study: Assessment of the Lake Bloomington Watershed

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Nitrogen reduction practices (tile drainage)

Practice	Expected reduction (%)
nitrification inhibitors	10
spring vs. fall fertilization	20
recommended rate vs. above[1]	
no-till vs. conventional	0
cover crops	25
water table management	40
shallow or wide tiles	25
conversion to CRP	95
conversion to perennial crops	80
constructed wetlands (20:1)	50
bioreactors	no data available

Iowa Strategy to Reduce Nutrient Loss: Phosphorus Practices

Practices below have the largest potential impact on phosphorus load reduction. Corn yield impacts associated with each practice also are shown, since some practices may increase or decrease corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% P Load Reduction[a]	% Corn Yield Change[b]
			Average (SD[c])	Average (SD[c])
Phosphorus Management Practices	Phosphorus Application	Applying P based on crop removal – Assuming optimal STP level and P incorporation	0.6[d]	0
		Soil-Test P – No P applied until STP drops to optimum	17[e]	0
	Source of Phosphorus	Liquid swine, dairy, and poultry manure compared to commercial fertilizer – Runoff shortly after application	46 (45)	-1 (13)
		Beef manure compared to commercial fertilizer – Runoff shortly after application	46 (96)	
	Placement of Phosphorus	Broadcast incorporated within 1 week compared to no incorporation, same tillage	36 (27)	0
		With seed or knifed bands compared to surface application, no incorporation	24 (46)	0
	Cover Crops	Winter rye	29 (37	-6 (7)
	Tillage	Conservation till – chisel plowing compared to moldboard plowing	33 (49)	0 (6)
		No till compared to chisel plowing	90 (17)	-6 (8)
Land Use Change	Perennial Vegetation	Energy Crops		
		Land Retirement (CRP)		
		Grazed pastures		
Erosion Control and Edge-of-Field Practices	Terraces			
	Buffers			
	Control	Sedimentation basins or ponds		

[a] - A positive number is P load reduction and a negative number is increased P load.
[b] - A positive corn yield change is increased yield and a negative number is decreased yield. Practi
[c] - SD – standard deviation. Large SD relative to the average indicates highly variable results.
[d] - Maximum and average estimated by comparing application of 200 and 125 kg P_2O_5/ha, respective requirements) (Mallarino et al., 2002).
[e] - Maximum and average estimates based on reducing the average STP (Bray-1) of the two highes (Mallarino et al., 2011a), respectively, to an optimum level of 20 ppm (Mallarino et al., 2002). Minimu
[f] - P retention in wetlands is highly variable and dependent upon such factors as hydrologic loading

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Extension and Outreach

Water Quality Improvement Case Study: Assessment of the Lake Bloomington Watershed

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Phosphorus reduction practices

Practice	Expected reduction % Tile drainage	Surface runoff
recommended rate vs. above		5
subsurface vs. surface broadcast		20
cover crops	5	25
shallow or wide tiles	+	-
conversion to CRP	50	75
conversion to perennial crops	50	95
WASCOB installation		75
sedimentation basins		95[1]
riparian buffers		50[2]
constructed wetlands		20[3]

Conservation practices

- nutrient-use efficiency (4Rs)
  - right source, rate, time, and place
- in-field management
  - cover crops, drainage water management, buffers strips, perennials
- off-site measures
  - bioreactors, wetlands, saturated lateral buffers, two stage ditches

Agricultural practices then applied by MLRA

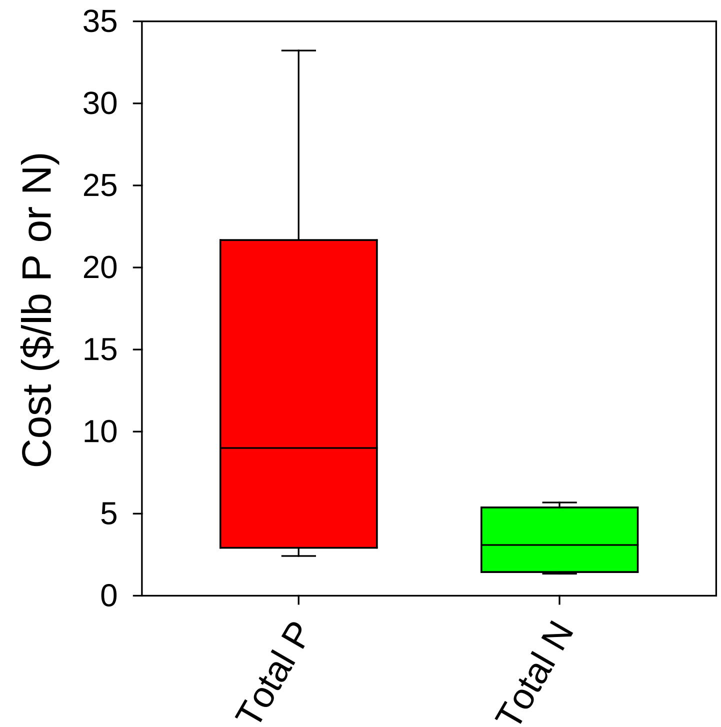
Costs per acre

	Practice/Scenario	Cost Per Acre	Notes
In-field	Reducing N rate from background to the MRTN (10% of acres)	-$8	Reduce N rates (20 pounds)
	Nitrification inhibitor with all fall applied fertilizer on tile-drained corn acres	$7	Cost of inhibitor
	Split (50%) fall and spring (50%) on tile-drained corn acres	$17	Additional field pass, switch to N solutions
	Fall to spring on tile-drained corn acres	$18	Switch to N solutions, higher ammonia price, additional application costs
	Cover crops on all corn/soybean tile-drained acres	$29	Aerial applications of cereal rye
	Cover crops on all corn/soybean non-tiled acres	$29	Aerial applications of cereal rye
Edge-of-field	Bioreactors on 50% of tile-drained land	$17	Upfront costs of $133 per acre
	Wetlands on 25% of tile-drained land	$60	5% of farmland out of production Major cost is land ($11,000)
	Buffers on all applicable crop land (reduction only for water that interacts with active area)	$294 per buffer acre	Land costs plus $50 planting, $10 yearly maintenance
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	$86	Less profit compared to corn-soybean rotation
	Perennial/energy crops on 10% of tile-drained land	$86	Less profit compared to corn-soybean rotation

P Reduction Practices

- Reduce tillage: -$16 per acre
  - One less field pass
- Eliminate P application for six years: -$15 per acre
  - Eliminate 6 years of applications, spread over 20 years to draw down P reserves
- Incorporate P: $6 per acre
  - Additional application costs

Point source P and N removal



$13.71/lb for total P at 1.0 mg/L

$3.30/lb for total N at 10 mg/L

Example Statewide Results for N

	Practice/Scenario	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lb N)	Nitrate-N Reduction % (from baseline)	Cost ($/lb N removed)
	Baseline		410		
In-field	Reducing N rate from background to the MRTN (10% of acres)	10	2.3	0.6	-4.25
	Nitrification inhibitor with all fall applied fertilizer on tile-drained corn acres	10	4.3	1.0	2.33
	Split (50%) fall and spring (50%) on tile-drained corn acres	7.5 to 10	13	3.1	6.22
	Fall to spring on tile-drained corn acres	15 to 20	26	6.4	3.17
	Cover crops on all corn/soybean tile-drained acres	30	84	20.5	3.21
	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02

Example Statewide Results for N

	Practice/Scenario	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lb N)	Nitrate-N Reduction % (from baseline)	Cost ($/lb N removed)
	Baseline		410		
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	Fall to spring on tile-drained corn acres	15 to 20	26	6.4	3.17
	Cover crops on all corn/soybean tile-drained acres	30	84	20.5	3.21
	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02
Edge-of-field	Bioreactors on 50% of tile-drained land	25	35	8.5	2.21
	Wetlands on 35% of tile-drained land	50	49	11.9	4.05
	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63

Example Statewide Results for N

	Practice/Scenario	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lb N)	Nitrate-N Reduction % (from baseline)	Cost ($/lb N removed)
	Baseline		410		
In-field	Reducing N rate from background to the MRTN (10% of acres)	10	2.3	0.6	-4.25
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In-field	Fall to spring on tile-drained corn acres	15 to 20	26	6.4	3.17
In-field	Cover crops on all corn/soybean tile-drained acres	30	84	20.5	3.21
In-field	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02
Edge-of-field	Bioreactors on 50% of tile-drained land	25	35	8.5	2.21
Edge-of-field	Wetlands on 35% of tile-drained land	50	49	11.9	4.05
Edge-of-field	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	10	2.6	9.34
Land use change	Perennial/energy crops on 10% of tile-drained land	90	25	6.1	3.18

Example Statewide Results for N

	Practice/Scenario	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lb N)	Nitrate-N Reduction % (from baseline)	Cost ($/lb N removed)
	Baseline		410		
In-field	Reducing N rate from background to the MRTN (10% of acres)	10	2.3	0.6	-4.25
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	Split (50%) fall and spring (50%) on tile-drained corn acres	7.5 to 10	13	3.1	6.22
	Fall to spring on tile-drained corn acres	15 to 20	26	6.4	3.17
	Cover crops on all corn/soybean tile-drained acres	30	84	20.5	3.21
	Cover crops on all corn/soybean non-tiled acres	30	33	7.9	11.02
Edge-of-field	Bioreactors on 50% of tile-drained land	25	35	8.5	2.21
	Wetlands on 35% of tile-drained land	50	49	11.9	4.05
	Buffers on all applicable crop land (reduction only for water that interacts with active area)	90	36	8.7	1.63
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	10	2.6	9.34
	Perennial/energy crops on 10% of tile-drained land	90	25	6.1	3.18
Point source	Point source reduction to 10 mg nitrate-N/L		14	3.4	3.30
	Point source reduction in N due to biological nutrient removal for P		8	1.8	

Example Statewide Results for P

	Practice/Scenario	Total P reduction per acre (%)	Total P reduced (million lb P)	Total P Reduction % (from baseline)	Cost ($/lb P removed)
	Baseline		37.5		
In-field	Convert 1.8 million acres of conventional till eroding >T to reduced, mulch or no-till	50	1.8	5.0	-16.60
In-field	P rate reduction on fields with soil test P above the recommended maintenance level	7	1.9	5.0	-48.75
In-field	Cover crops on all corn/soybean acres	30	4.8	12.8	130.40
In-field	Cover crops on 1.6 million acres eroding>T currently in reduced, mulch or no-till	50	1.9	5.0	24.50
Edge-of-field	Wetlands on 25% of tile-drained land	0	0	0.0	
Edge-of-field	Buffers on all applicable crop land	25-50	4.8	12.9	11.97
Land use change	Perennial/energy crops equal to pasture/hay acreage from 1987	90	0.9	2.5	102.30
Land use change	Perennial/energy crops on 1.6 million acres>T currently in reduced, mulch or no-till	90	3.5	9.0	40.40
Land use change	Perennial/energy crops on 10% of tile-drained land	50	0.3	0.8	250.07
Point source	Point source reduction to 1.0 mg total P/L (majors only)		8.3	22.1	13.71

USLE method

Example Statewide N & P Scenarios

Name	Combined Practices and/or Scenarios	Nitrate-N (% reduction)	Total P (% reduction)	Cost of Reduction ($/lb)	Annualized Costs (million $/year)
NP1	MRTN, fall to spring, bioreactors 50%, wetlands 25%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on all applicable lands, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	35	45	**	383
NP2	MRTN, fall to spring, bioreactors 50%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on all CS, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	45	45	**	810
NP3	MRTN, fall to spring, bioreactors 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 87.5% of CS, buffers on all applicable lands, perennial crops on 1.6 million ac >T, and 0.9 million additional ac.	45	45	**	791

Example Statewide N & P Scenarios

Name	Combined Practices and/or Scenarios	Nitrate-N (% reduction)	Total P (% reduction)	Cost of Reduction ($/lb)	Annualized Costs (million $/year)
NP1	MRTN, fall to spring, bioreactors 50%, wetlands 25%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on all applicable lands, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	35	45	**	383
NP2	MRTN, fall to spring, bioreactors 50%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on all CS, point source to 1.0 mg TP/L and 10 mg nitrate-N/L	45	45	**	810
NP3	MRTN, fall to spring, bioreactors 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 87.5% of CS, buffers on all applicable lands, perennial crops on 1.6 million ac >T, and 0.9 million additional ac.	45	45	**	791
NP4	MRTN, fall to spring N, bioreactors 35%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, buffers on 80% of all applicable land	20	20	**	48
NP5	MRTN, fall to spring N, bioreactors 30%, wetlands 15%, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, point source to 1.0 mg TP/L and 10 mg nitrate-N/L on 45% of discharge	20	20	**	66
NP6	MRTN, fall to spring N, no P fert. on 12.5 million ac above STP maintenance, reduced till on 1.8 million ac conv. till eroding > T, cover crops on 1.6 million ac eroding >T and 40% of all other CS	24	20	**	244

Practice list summary

- what we included:
  - fertilizer amounts, timing, placement
  - reduced tillage
  - cover crops
  - bioreactors
  - wetlands
  - riparian buffers
  - perennials
- also consider:
  - drainage water management
  - sidedressing fertilizer

Now we need to do it

- point sources already started on P
  - will be looking to agriculture to make reductions as well
- Illinois Farm Bureau, Corn Growers, IFCA, and ICBMP all behind strategy
  - all voluntary for agriculture
- Nutrient Research and Education Council (NREC) has funded projects to further evaluate practices
- strategy will be updated periodically

Illinois Nutrient Loss Reduction Strategy

Thursday, September 24, 2015

ShareThis

Final Nutrient Loss Reduction Strategy for Illinois has been released!

The Illinois Environmental Protection Agency (IEPA) and the Illinois Department of Agriculture (IDOA) have officially released the final version of the Nutrient Loss Reduction Strategy (Strategy) for Illinois. Download the full Strategy here.

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY
Improving our water resources with collaboration and innovation

The Strategy outlines a framework for reducing nutrient losses to improve Illinois water quality and the quality of water leaving the state and making its way to the Gulf of Mexico.

Illinois Farm Bureau (IFB) worked with a wide range of stakeholders, including other agricultural groups, wastewater treatment plant representatives, and environmental groups, to develop the Strategy through a process led by the IEPA and the IDOA. Agriculture will continue working to address losses from our family farms, but everyone—whether from rural, suburban or urban areas—will have a role to play.

IFB supports the Strategy because education, outreach, and voluntary, incentive-based best management practices (BMPs) will continue to be the primary tools for addressing nutrient losses from Illinois farm fields.

The focus is on reducing nutrient losses to the environment, not on reducing nutrient use for Illinois agriculture. For agricultural non-point sources, voluntary implementation of BMPs is expected to build on efforts already underway by farmers throughout the state and in watersheds with existing nutrient management plans. It is expected that the implementation of BMPs will increase with additional outreach, education, and incentives.

This is Illinois agriculture's opportunity to prove that voluntary conservation does work!!

Join IFB

NLRS Videos

The Science Behind the Strategy - Phosphorus

The Science Behind the Strategy - Nitrogen

Quick Reference

Watch these videos featuring **Mark David**, an NLRS researcher from the University of Illinois, and **Marcia Willhite**, Chief Bureau of Water for IEPA.

Follow these links for more background information:

Illinois EPA's Executive Summary of the Strategy

Illinois EPA's Factsheet on the Strategy

Illinois EPA and IDOA's News Release regarding the Strategy

IFB Summary of the Strategy

Showing Progress

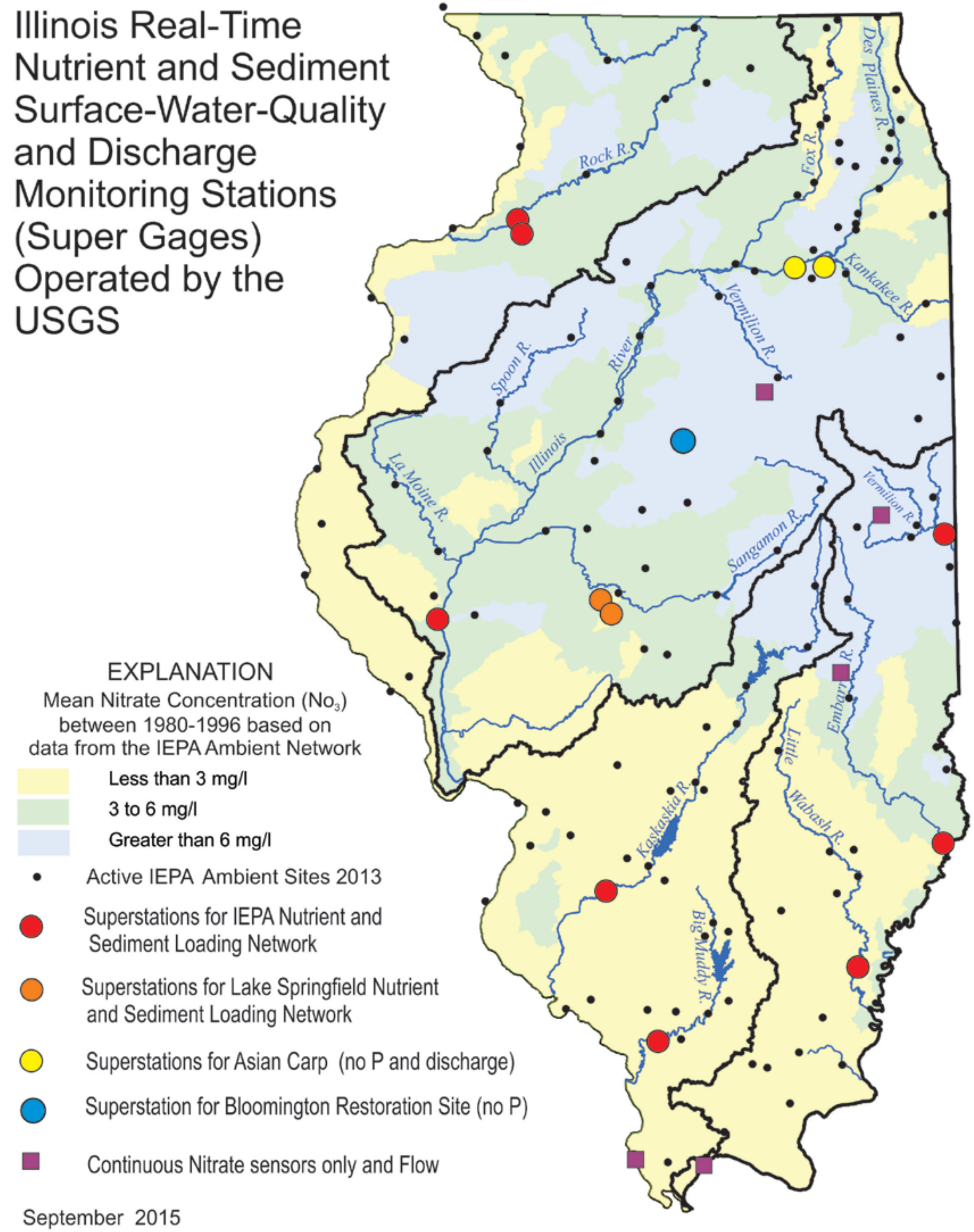
- track implementation activities and environmental outcomes
  - National Pollutant Discharge Elimination System (NPDES)
  - 319 program
  - Soil Conservation Transect Surveys
  - Natural Resources Inventory
  - NRCS Annual Report
  - Ag Industry Voluntary Reporting
- monitoring programs – local water quality/nutrient loads
  - Statewide Nutrient Export Loadings Network

USGS/IEPA Monitoring

- Basins covering ~75% of Illinois
  - Rock River
  - Green River
  - Illinois River
  - Kaskaskia River
  - Big Muddy
  - Little Wabash
  - Embarras River
  - Vermilion River

- Current USGS gaging station (flow)

- Current IEPA Ambient site/Historical Data



Implementation Status Workgroups, Forums, and Councils

- Nutrient Monitoring Council – May 5 and Sept. 16, 2015
  - next meeting Dec. 3, 2015
- Ag Water Quality Partnership Forum - May 22, August 26, and Sept. 22, 2015
  - next meeting Feb. 16, 2016
- Urban Stormwater Working Group – July 20, 2015
  - conference call Dec. 11, 2015
- Nutrient Science Advisory Committee held first meeting Nov. 19, 2015
- Policy Working Group – August 4 and Nov. 18, 2015
  - next meeting March 8, 2016

Will the Illinois NLRS work?

- 45% reductions are large
- both point sources and agriculture need to make major changes
- right now everyone is committed
- monitoring will tell us